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CHEMICAL & METALLURGICAL ENGINEERING

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July 6, 1921

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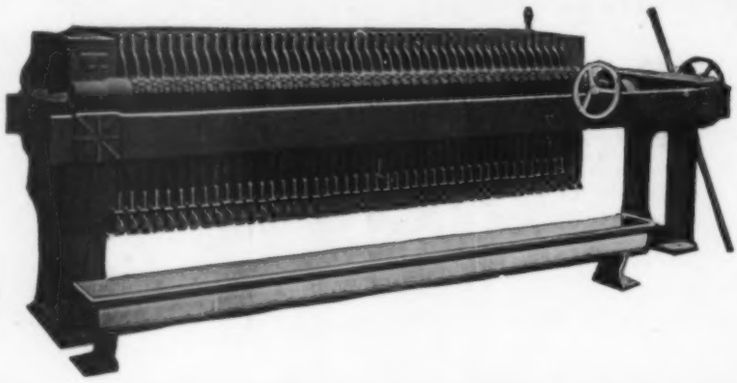

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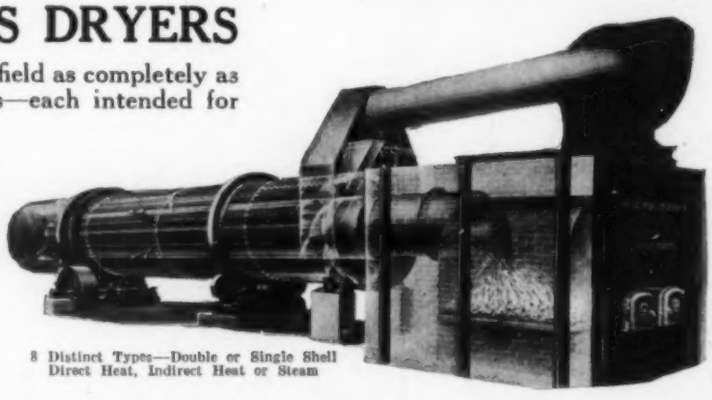

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Long-Time Forest Policy

THE paper industry in the United States, covering as it does paper board, newsprint, book, wrapping and many other grades of product, represents a tremendous output both in tonnage and value. A very large percentage of this chemical industry is dependent upon wood-pulp supply as its raw material, and as a consequence is vitally concerned in the forest policy which the nation may adopt. It is estimated that the paper industry uses five and one-half million cords of wood a year, the equivalent of forty to eighty years' growth of timber on a half million acres of forest land. It is easy to see, therefore, why a long-time policy rather than any year-to-year planning is essential.

In this planning three major points require consideration: First, the problem of efficient utilization of the forests which are cut; second, the protection of forests against wasteful attack, either by commercial depredation or forest fire; and third, a reforestation policy that is adequate to the national need.

In many parts of the country there are today lumbering activities which from the chemical point of view are most wasteful. For example, in the neighborhood of Puget Sound the Forest Service believes that the cutting of lumber is accompanied by the waste of much more than enough pulp wood not useful for lumber than would be required for the supply of several good sized pulp mills. If in this territory market for this pulp wood were created by establishment of a modern mill, of say 100 tons per day capacity, it seems certain that more than an adequate supply of wood would be offered at once. This material would come from the forests being cut for lumbering operations where a considerable percentage of the trees is now wasted because they are unsuitable for the local lumber markets, though they are well suited to pulp production if such market were available.

In many other parts of the West there are other possibilities in development of chemical industry for pulp-wood production that are most attractive. For example, in the neighborhood of the forest reserves under the control of the Forest Service the investment for paper production is most effectively minimized by the generous plan which the Forest Service offers to any who require this type of forest supply. Under this scheme it is necessary only to make a deposit on a contract for pulp wood to permit extensive cutting. These deposits are usually $10,000 each, which will allow cutting to any extent permitted under proper forester control up to the total of the deposit and at any rate that may suit the need of the purchaser. When the first deposit is thus used up it is necessary only to make a second deposit on the contract and thus continue over a period of years with ample forest reserve assured at a minimum capital investment. Of course in any of these cases the economic factors of the situation must be considered in order to insure commercial success, but the prospects seem most attractive in many circumstances.

The destruction of forests by fire in the territory nearer paper markets is even more alarming than the waste of pulp wood in the West. It is estimated by the Forest Service that these losses amount to over four million acres valued in excess of thirty million dollars per year. The consequence of these forest losses upon the cost of pulp wood and paper is obvious. Adequate protection by co-operation of state and federal authorities is of greatest importance to the industry.

There are also many problems of permanence in this industry which are dependent upon reforestation and maintenance of national forests. These are the problems which require vision for long-time development, but they are just as vital to permanence of investment and adequacy of future supply as any of the others. It is high time that the chemical industries involved should concern themselves with these problems from a chemical point of view, for they have chemical need as well as broad economic significance.

The Permanent Tariff Revision

TARIFF legislation, difficult to frame even under normal conditions, has been complicated by many unusual factors. The domestic industry, suffering under severe depression, asked not only for the restriction of foreign competition, but for legislation which it thought would assist it in recovering and expanding our export trade. Our change from a debtor to a creditor nation and the tremendous obligations of foreign countries which can only be repaid with goods have resulted in an uncertain and unsettled international situation. The measure for the revision of the permanent tariff, which has just been reported by the Ways and Means Committee, must be regarded, therefore, only as the initial attempt at the solution of an extremely perplexing problem.

It is difficult to compare the new bill with former tariff legislation. It has been framed to meet an entirely different situation and it is only natural that its framers have been forced to resort to many new and unusual provisions. Home valuation, retaliatory duties, anti-dumping, and the principles of the bartering tariff, although more or less foreign to our customs practice, have apparently been warranted by the specific conditions confronting our industries.

The chemical schedule of the new bill, which has been given detailed study on other pages of this issue, also

contributes its share of innovations. The special protection demanded by the dye industry has resulted in the proposal of a new form of control, which presumably is calculated to meet the growing opposition to the original licensing scheme. Likewise, potash and the other so-called war minerals have called for unusual treatment.

The reporting of the new bill marks the opening engagement of the impending tariff battle, the outcome of which will be awarded with anxious concern. Rumors are already afloat to the effect that opposing elements are dissatisfied with many of the provisions and that new schedules will have to be written or new compromises effected. The metal schedule particularly was the subject of violent criticism as soon as its contents became known. The entire bill will necessarily be modified before it leaves the House, some of its provisions will be rewritten in the Senate, and, finally, the last minute changes will be made in conference.

Need of Better Association Machinery

WHEN necessary to increase plant production a manager usually has the choice of installing more machines or removing the present equipment and putting in better machines. In technical association affairs we are nationally in just that situation today. And, unquestionably, *better* association methods and machinery are needed.

Recently in Washington a conference of engineering society representatives considered the problem of some sort of engineering association and engineering club. At once two problems arose: First, how to get cooperation and efficient working together, and, second, how to avoid neglect of the specialties within chemistry and engineering that fully justify separate associations or institutions.

Almost everyone can recall from pre-war days the old association "table of equivalents" jokingly cited in reference to German technical society affairs. This started out by making two persons an association, three associations a federation and so on up until the entire universe was affiliated. This reference to the system, which we might call "a much-machinery system," points clearly to the evil of creating a new organization or club every time there is some rather new function to perform. The result obviously is only more wheels and charts of relationships, all of which consume much time and energy and give but little in compensating results.

For local affiliations such as proposed in Washington there is one scheme which really has worked. This provides a local office with a secretary from which are sent out common notices to the mailing list of all the affiliated bodies. Thus all members of all societies are reached regularly with notice of every activity in which they may be interested. It is to be hoped that some similar scheme may be evolved for Washington and that it will succeed as well there as it has in Cleveland, Buffalo and elsewhere. In fact it is to be hoped that Washington will add new variations or create a new scheme of this sort that is even better than those yet reached. Engineers and chemists are much too busy persons to welcome more societies or more affiliations of societies if they do not replace rather than supplement the present. Better association machinery is certainly all we need, not more associations.

Other Views on The Mineral Tariffs

MARC PAWL'S article on the mineral 'tariffs has elicited some comments from our readers, which we are pleased to print on another page of this issue. At the outset, however, we must admit that we are disappointed because our correspondents have, for the most part, ignored the broader questions of conservation and national policy and have confined their views to the purely tariff issues presented by the individual minerals in which they are interested. We are glad to learn, for instance, that with scientific methods our crucible makers can use Alabama graphite to better advantage than the Ceylonese product, although this does not exactly confirm the reported experience of the twelve manufacturers who opposed the tariff on graphite at the hearings last February. "Searles Lake would keep us going at the present rate of consumption [of potash] for 75 or 100 years and doubtless by that time our chemists will be making potash out of soda." We don't want to discourage our potash alchemists, but might they not better divert their energy toward finding a cheaper means of transporting the Searles Lake product to its South Atlantic market?

But all that this proves is that the tariff still is, and probably always will be, a fruitful source of controversy.

Expecting Arrest Or Protection?

ONE of our most prominent citizens recently remarked that industry long has regarded the Government as a policeman rather than as a friend. No doubt much of industry has taken this attitude—to what extent because it had a guilty conscience is worth considering.

If you drive your automobile up to a street intersection at forty-five miles per hour, which is above speed limits even in New York City and Los Angeles, our two coast cities of greatest speed and size, what would you expect of the officer at the "Stop-Go" semaphore? For our part we should expect that you would get a summons in next day's mail, if you were not more promptly invited to join an officer in a ride to the nearest precinct station. On the other hand, driving up with the car under control, with cut-out closed and if necessary making a stop before reaching the sidewalk line, you properly expect, and you get, a courteous signal from the officer for a *protected* crossing of the intersecting street.

The Secretary of Commerce is calling group conferences from industry to meet with him and his principal assistants to discuss statistics, standardization and simplification, and other basic matters of commerce and industry. It is a question how he shall be approached by industrial representatives. It is economic traffic which he desires to protect and direct; and the economics of this traffic, therefore, must be considered.

Chemicals, iron and steel, non-ferrous metals, rubber, textiles and all the other groups of products from chemically-controlled industry will in time receive attention. If they approach the crossing within the economic speed limit, they will obtain from the worthy Secretary and the capable associates whom he is gathering about him economic signals invaluable to their traffic movement. It is not a blustering, red-faced, bull-necked officer that they are to deal with. It is a courteous guard of business movement who knows more in many cases than industry itself about how each part of industry should move for

the safety and speed of all. An approach in this spirit by industry will facilitate getting of much-needed governmental advice.

The comparison must not be pressed too far, however. If we disobey the traffic officer at the corner, more than likely we shall be "pinched." Almost certainly the least we get is a publicly administered reproof. In dealing with the Department of Commerce, however, it will be only advice and guidance of the most friendly sort that will be furnished. The decision as to whether industry will "stop" or "go" will remain with the business executive, where it belongs under our system of government. On behalf of the Department of Commerce therefore, and in the interest of business itself, let us hope for and insist upon a relationship of co-operation; and let us put aside fear of the Government, the old-fashioned bogey of our national industrial childhood. Certainly it would seem that industry had long since outgrown it.

The Return of Industrial Activity

IT IS quite clear that for a return of industrial activity we require something more than removal of the causes that produced the depression. Roughly speaking, the case is analogous to a patient suffering from a germ disease. Complete recovery does not instantly follow disappearance of the germs. The patient must convalesce, or get over the results of the disease. On this account we must not pin too much faith to "deflation" or insist that when certain commodity prices have come down others must come down by similar amounts before business can be ready to go forward.

Perhaps, indeed, we have been a little too critical about prices. The idea is right, but almost anything can be carried too far. Some months ago a common thought was that prices would have to get down to a certain relation to pre-war levels, the chief question being what that relation should be. As certain commodities declined we were disposed to take them as standard and expect other commodities to do likewise. No longer can we hold to any such doctrine. There is zinc, for instance. It is not down to its pre-war average. It is 8 per cent below its lowest in the five years before the war.

Nor can we follow what might be called a corollary to the theory that price deflation by itself will remove the industrial depression, that the commodities that first get down to the proper price level will first become active, for in many cases it is an especially light demand that has forced one commodity or another to a particularly low price, relative to the general average.

Now that we have before us recovery from the influences of depression as well as from the causes of depression, demand or activity is not going to revive by commodities, but rather by classes of consumption. To illustrate concretely, both nails and lumber are used in dwelling house construction and in making boxes for the shipments of a wide vareity of merchandise. If lumber came down and nails stayed up, we ought not to expect the demand for lumber to become heavy, with the demand for nails remaining light.

Throughout the country there has been underbuying for months. No doubt this started by "a strike of buyers," but it has gone beyond a voluntary act, for with so much unemployment and so much reduction in wages and salaries the power to buy has been greatly reduced. Few can now buy what they would like to have. What people will buy first will be the things they need most and, to an extent, what they think are the better investments, preference being given where possible to commodities that seem the cheapest. The things that wear out the most rapidly or are most useful will experience the first revival in demand.

Obviously the beginning of industrial revival will not be in construction work. That is something that can most readily be postponed. The common everyday commodities, things that have only a short life at best, will be bought first. Then there will be more employment, increased buying power and a further increase in buying. The steel industry, for instance, which is now running at 20 per cent or less of capacity, or at a lower rate than is necessary merely to take care of the country's wear and tear, will find its first revival in demand not in steel for construction work, but in steel for restoring the wear and tear on railroads, the replacement of tools and agricultural implements, and in channels of that general description. The most unlikely thing is that industrial revival will begin with a "building boom."

Talking in Large Figures

IN 1914 the Census of Manufactures reported the total value of manufactured products as 24 billion dollars. The preliminary summary of the 1919 census gives a corresponding figure for all industries of 60 billion dollars, an increase to 250 per cent of the previous value. These numbers are rather too big to digest as a whole, and therefore it is worth while to pick them to pieces and see what they really mean.

It would not be at all reasonable to assume that the American people were producing and using or exporting two and one-half times as much in manufactured commodities in 1919 as they did five years before. Everyone knows that the value of a dollar as measured by commodity in the later year was much less than in the earlier and that corresponding change in the so-called "value" of the manufactured products appears in these summaries. It is perhaps fair to assume that the index number for 1919 was 215 on a basis of 100 for 1914. In any event authorities on this subject disagree sufficiently so that this is as good an estimate as one can be sure of. If we divide 250 per cent by 215 per cent we get a result which is really representative of the ratio of commodity in the latter year to commodity in the former. By such division one can arrive at the conclusion that about 115 per cent as much of manufactured goods was produced in the country in 1919 as in 1914.

During the same period of five years we may assume that the population changed by about half as much as during the time between the census years 1910 and 1920, or in other words there was perhaps a 6 or 7 per cent increase in population. This change in population should be compared with the change in manufactured goods.

The standard of living of a country may be measured by the quantity of manufactured goods used per capita. This is by no means the only unit, but it is certainly one of significance. For such measurement it is necessary only to compare the 115 per cent in goods with 107 per cent in population. Thus we can safely conclude that there was by and large through the country an increase in the American standard of living. To say that it amounted to 6, 7 or 8 per cent according to just how one figures would be improper, for standards of this sort cannot be measured exactly in percentage.

Readers' Views and Comments

Chemical Patent Claims

To the Editor of Chemical & Metallurgical Engineering

SIR:—With reference to my article published in CHEMICAL & METALLURGICAL ENGINEERING May 18, 1921, pages 883-4, relating to the case of Miami Copper Co. vs. Minerals Separation Co., it has come to my attention that some readers have construed this paragraph as referring to the Callow cell. It was not intended to convey any such impression; the court found infringement in three previous steps of the process, including the Pachuca tank in which agitation was caused by the air-lift effect.

CHESTER H. BIESTERFELD.

Rhodium From Rodents

To the Editor of Chemical & Metallurgical Engineering

SIR:—Here is the claimant for your "Flor de Convolvulus Scoparius."

Do you know you gave me a very bad five minutes, being the interval between the time that I read your comment on my "rhodium" article and that required to get at the "Encyl. Britt." It was not that I was not well acquainted with oil of rhodium as a rat bait, but that a horrible suspicion seized me that I had spelled it wrong and that the plant might be rodium without the "h."

Your apology is most handsome so we will shake hands (across the sea) and part good friends.

Princetown, England. THOMAS C. BRIDGES.

Exhibition for the American Ceramic Society

To the Editor of Chemical & Metallurgical Engineering

SIR:—Referring to the editorial in your May 25 issue, in which you suggest an exhibition for the American Ceramic Society, you might be interested to know that the Art Division is working on a program which will assure the periodical exhibition of ceramic wares under conditions most favorable to each class of product.

Many members of the American Ceramic Society are also members of other organizations such as the Architectural League, National Academy, the National Woman's Painters and Sculptors, etc., and ideas dealing with the development and exhibition of artistic wares are being given serious consideration by these bodies.

An exhibition embodying anything like a representative collection of present-day domestic ceramic wares will be a rather large undertaking, and it is not expected that the first exhibition will do more than demonstrate the possibilities of a comprehensive show to every interest and activity in the ceramic field.

Without taking into consideration the many types of utilitarian and ornamental wares produced in this country, all of which should be shown in their respective groups, we have three classes of productive work, each one a powerful influence and force especially when their activities are co-ordinated, which is unfortunately not the case at this time, although serious efforts are being made to bring these forces together. These three classes are: Factory production, studio production and school production. As the American Ceramic Society exhibitions are intended to be primarily educational in character, every effort will be made to show typical examples of all three classes.

While, as stated, these three active interests are working independently, often unsympathetically, and rarely possessing an appreciation and understanding of the importance and value of the others, there is happily a greater general interest in the development of artistic pottery and architectural faience than is often admitted by those who are too close to their respective activities to possess a true perspective. The Apprentice Schools of Design, the Art Alliance of America and many other organizations are actively interested. The press is giving due recognition to the need for development in ceramic art work. Your own valuable publication has been most liberal in this respect.

All of this goes to show that rational co-operative action among the interests mentioned is all that is needed to bring results, and this is the end toward which the Art Division is working.

Zanesville, Ohio. FREDERICK H. RHEAD,
Chairman Art Division.

Treatment of Acid and Alkali Burns

To the Editor of Chemical & Metallurgical Engineering

SIR:—In regard to question of acid and alkali burns, published in your April 27, 1921, issue, may I state that in the Steffens department of beet sugar mills a rather painful burn is often experienced due to calcium saccharate? It has been my experience and observation that this unstable substance does not attack healthy, unbroken skin at all; but let there be the least contusion, scratch or friction from coat cuff or shoe, and there is trouble. The first stage is a redness with itching, which unless stopped passes to a peeling of the skin at various minute points. In these two stages a not too dilute acid will stop all further action. The third stage, which generally takes thirty minutes or longer to appear, is a number of small discolored, painless spots which are a true burn with tissue destruction. Unless drastic treatment is used here these burns will spread, grow and may run together to a very painful, sickly gray, sunken sore by the next day. I have seen them grow over night from almost unnoticeable points to the size of quarters.

In sugar mills accident cases are cared for in the laboratory. In one such laboratory the custom is to pour on rather concentrated acetic acid and make the workman walk *across* the laboratory before being allowed to wash off the acid. He is then stuck up with surgeon's tape and the result is generally successful. I prefer the more drastic, more painful, but absolutely certain treatment of using commercial HCl direct from carboy and leaving it on the burn till all effervescence (from the CaO) ceases, then washing well with water and soda and wiping with oiled rags. Burns then heal up in short order.

When one gets the saccharate in the eye it should be washed copiously with water—if none is handy, use

spittle—treat with weak acetic acid at once, and put in a few drops of olive or other equivalent oil. This stuff often slakes with mild explosion when in presence of hot water.

I am told that the barium saccharate is even nastier to handle from standpoint of burns.

Fort Morgan, Col. M. SHERRILL.

Device for Measuring the Flow of Gases

To the Editor of Chemical & Metallurgical Engineering

SIR:—I noted with interest the comments by Messrs. Knowland, Donaldson and McCollum in your June 1 issue in reference to my paper "A Device for Measuring the Flow of Gases," appearing in your May 4 issue. It is possibly true, as pointed out, that my paper was misleading because it did not mention the corrections which should be applied in using the instrument calibrated with air. The object of my paper was merely to suggest the use of pipe fittings for building a measuring device. I pointed out that the principle was well known and therefore did not discuss it in detail. I am accustomed to make the corrections suggested, which are, of course, obvious, and I am sorry if anyone has been led to believe that the apparatus could be used without correcting the air calibration curve. The molecular weights of the gases that I have used are known and the corrections easily applied; with some gases it might be more difficult. CARLE R. HAYWARD.

Mass. Inst. of Technology,
Cambridge, Mass.

The Tariff on Minerals

To the Editor of Chemical & Metallurgical Engineering

SIR:—In the article "The Tariff on Minerals," by Marc Pawl, in the June 8 number of CHEMICAL & METALLURGICAL ENGINEERING is included a paragraph on potash. It is unfortunate that the author did not take the trouble to get the facts before committing himself in writing. But facts do not always fit satisfactorily into a preconceived argument.

For example: Mr. Pawl makes the statement, "There is no likelihood of our being able to supply our needs from these sources" (natural brines). On the contrary, nothing is more likely. If the future of the industry is secured by adequate tariff protection, it would be easily possible for us to supply our needs from Searles Lake or Salduro Marsh alone inside of, say, two years. The potash is there and the methods of recovery are known. All that is needed is the capital to finance the plants, and this will quickly be forthcoming as soon as the future of the industry is reasonably secure. Searles Lake would keep us going at the present rate of consumption for seventy-five or a hundred years, and doubtless before that time our chemists will be making potash out of soda or some other element. But if they haven't accomplished this yet, we can start in on Salduro Marsh and run along for another century.

It is unfortunately true, as Mr. Pawl says, that we are still dependent on the German and French deposits for a large part of our potash, but there is no more reason for it than there was for our dependence on Great Britain for our tin-plate thirty years ago. If we had lacked the sense to protect our tin-plate people for a time, we should still be importing tin-plate instead of underselling the British in their own markets.

Mr. Pawl makes the statement that the proposed tariff will add 75 per cent to the cost of potash. He does not mention the base upon which he figures his 75 per cent. . . . By some arithmetical gymnastics it is possible to figure the increase all the way from 20 per cent to 66⅔ per cent, but to get up to Mr. Pawl's 75 per cent one must abandon facts and imagine a price which never was.

Finally, Mr. Pawl calls attention pathetically to the fact that the farmer will pay the increase. He fails to show that the proposed tariff will lay the appalling burden on the cotton farmer of not to exceed 30c. per acre. It will increase the cost of tobacco growing by the terrifying sum of less than three-tenths of one cent per pound. It will inflict on the potato farmer the frightful load of two or three cents additional cost per bushel.

Laying aside sarcasm, it is perfectly true that the farmer has his troubles and always will have until weather is made to order, bugs and plant diseases sent the way of the dodo and the Tasmanian, and marketing made a dead certainty. One of the American farmer's chief troubles in recent years has been the fact that he was so largely dependent on European sources for his potash. A small tariff for a temporary period will relieve him of this burden and at the same time enable the country to develop a new and important source of wealth and prosperity. In these circumstances, Mr. Pawl should shunt his pathos into some other channel and make an effort to help the good work instead of hinder it.

U. S. POTASH PRODUCERS' ASSOCIATION,
BY FREDERICK W. BROWN, Secretary.

Washington, D. C.

To the Editor of Chemical & Metallurgical Engineering

SIR:—I feel that if Marc Pawl is as poorly informed concerning other minerals as he is regarding flake graphite he should not be allowed the space in your valuable journal for his propaganda.[1]

Mr. Pawl probably does not know that American business men have invested approximately $6,000,000 in the development of Alabama graphite deposits alone; that Alabama could supply all the crucible stock and other flake graphite products required in the United States for years; that the quality of Alabama graphite is so much superior to Madagascar that the Quenelda Graphite Corporation, Lineville, Ala., was able to sell No. 2 flake graphite (second grade flake) in the open market at the same price as the No. 1 Madagascar graphite sold at during October, 1920.

Furthermore, Mr. Pawl probably does not know that the Bureau of Mines, U. S. A., under the direction of Mr. Stull of Pittsburgh, has proved that Alabama graphite can be used to better advantage in the manufacture of crucibles than Ceylon lump graphite, provided the manufacturer uses scientific methods in selecting and mixing his fireclay.

While Mr. Pawl is trying to protect the foreign investments of Americans, let him not forget the investments of Americans in American industries, without which we would have lost the European war.

Imports and exports are so much discussed these days that few people realize that these are only a small fraction of the total business of the country.

New York City. CHARLES A. BURDICK.

[1] EDITOR'S NOTE.—We do not regard Mr. Pawl's paper as propaganda, but rather as an unusual and interesting viewpoint of our mineral industries.

GRAND CIRCUS PARK IN THE HEART OF THE BUSINESS DISTRICT OF DETROIT

The Detroit Meeting of the American Institute of Chemical Engineers

Relation of the Chemical Engineer to the Automotive Industries Is the Keynote of the Summer Meeting —Papers Stress Metallurgy, Automobile Tires, Paint and Fuel—Excursions to Ann Arbor and Salt Mines at St. Clair

THE American Institute of Chemical Engineers met in Detroit, June 20 to 25, for the thirtenth semi-annual meeting. An enterprising local committee under the leadership of Chairman C. T. Bragg provided a week of pleasant and profitable entertainment and extended to the Institute the gracious hospitality of their busy and beautiful city. The well-rounded program included such interesting diversions as boat rides, dinner dances, banquets and barbecues. In addition to the usual business sessions there were excursions to the University of Michigan at Ann Arbor, and to the great salt mines at St. Clair. Many of the famous automobile factories and important chemical plants in the vicinity of Detroit were also visited by the chemical engineers.

The entertainment of the wives and feminine guests of members of the Institute was in the hands of a special committee under the direction of Miss Sarah Burnham of Detroit. The ladies' program substituted afternoon teas and shopping tours for the business sessions and plant inspections, but fortunately the programs converged for the dances and similar festivities.

Report of Committee on Education

The New York members of the Institute and their friends arrived in Detroit Monday morning after a boat trip up the Hudson to Albany and across Lake Erie from Buffalo. Immediately following their arrival President David Wesson called to order the first business session. The Institute was officially welcomed to the city of Detroit in a brief talk by John C. McCabe, research engineer for the city and personal representative of the mayor. Reports of the Council, the secretary and treasurer were then read by the secretary, J. C. Olsen. Dr. A. D. Little, chairman of the committee on chemical engineering education, presented as a progress report of his committee the tabulated results of the survey of chemical engineering courses in the principal universities and colleges of the United States. These tables, which had been printed in a previous issue[1] of CHEMICAL & METALLURGICAL ENGINEERING, were used as the basis of an interesting discussion.

Dr. Little called attention to the great diversity of subjects included in 278 different courses offered by the institutions and pointed out the evident need for a certain amount of standardization. Other features of the report were the difference in the weighting of the various courses and the tendencies toward specialized instruction by certain universities, such, for example, as the courses in sugar at Louisiana, pulp and paper at Maine, and coal and ceramics at Illinois.

An interesting tabulation made by the committee showed that in ten important institutions the time devoted to chemistry lectures varied from 240 to 1,288 hours, with an average of 650 hours. The laboratory work ranged between 482 and 2,144 hours and the average was 1,148. Similar differences in requirements were shown to exist for the courses in physics, mathematics, mechanics and engineering. Additional charts and summaries are to be printed in the final report of the committee and the hope was expressed by Dr. Little that his committee might have the continued co-operation of the Institute in its study of this important subject.

Favors Working Clause in Patent Law

A report from the chairman of the committee on patents was read by the secretary and led to a discussion of the recent proposals to incorporate a working clause in the patent law. Henry Howard, who spoke in favor of such legislation, declared that the dye industry in this country had been throttled by the absence of a requirement for compulsory working of patents. Following other discussion, both favoring and opposing the working clause, a committee was appointed, with Mr. Howard as chairman, and was instructed to draft resolutions to Congress. These resolutions, presented and passed in a later meeting

[1] CHEM. & MET. ENG., vol. 24, pp. 1047-53, June 15, 1921.

of the Institute, recommended the passage of a law similar to the British compulsory working act of 1907.

Chemical Engineering in Paint Industry

Dr. C. D. Holley, director of research for the Acme White Lead & Color Works, presented the first technical paper, which was an interesting account of "the manufacture and application of automobile finishes." Notwithstanding the fact that less chemical engineering has been devoted to the paint and varnish industry than to any of the other modern industries of similar magnitude, there are nevertheless certain engineering features worthy of mention. In many instances these developments from an engineering standpoint are directly attributable to the influence of the automobile industry, especially as related to quantity production.

Fume Collection

One problem in the manufacture of varnishes which the chemical engineer has helped to solve has been the efficient collection and recovery of fumes.

"From 10 to 25 per cent of the weight of the varnish gums used is driven off in the melting of the gums. These products of decomposition pass up the varnish stacks and are disseminated in the air in quantities that sometimes reach several thousand pounds daily.

"This has necessitated the installation of an efficient fume control system whereby these fumes can be condensed as they leave the kettles or can be made to enter into a chemical combination and thereby be eliminated. This has required some really ingenious chemical engineering practice, as the problem was not an easy one to solve because of the physical and chemical nature of the fumes and the fact that the gums are 'run' in the varnish kettles at nearly their flash point and any undue disturbance in the equilibrium of the gases in the kettle often means a bad fire. These installations have proved quite successful, affording usable byproducts and in several instances have permitted a 50 per cent reduction in insurance premiums in addition to allowing the varnish maker to continue manufacture undisturbed by the authorities."

Pyroxylin Artificial Leather

Dr. G. C. Given described the manufacture of pyroxylin artificial leather. He pointed out that the enormous requirements of the automobile and furniture industries have greatly stimulated the manufacture of leather substitutes. The production of adequate quantities of satisfactory upholstery material has resulted in an industry in which there are now fourteen factories with a total invested capital in excess of $50,000,000.

Of the three general types of leather substitutes—viz., vulcanized oils, rubber and pyroxylin—the last named is probably used in the largest quantity. In the manufacture of artificial leather from pyroxylin, the fabric is dyed and properly dried, and is then coated with a "dope" composed of special nitrocellulose, oil, solvent and pigment. This is spread on the cloth in successive thin coats numbering from five to fifteen, according to the quality desired. After the fabric has received the requisite quantity of coating, the product is passed into embossing machines which impress on the pyroxylin compound a grain resembling that of high-grade leather. For the production of the best qualities of artificial leather the embossed goods are finished by hand in order to obtain the artistic effects of old Spanish leather.

SCENE ON THE RIVER AT BELLE ISLE

Monel Metal

William M. Corse presented a paper on the properties and uses of Monel metal. This comparatively new and valuable alloy was originated in 1905 and was named after the late president of the International Nickel Co., Ambrose Monell. It is obtained from a nickel-copper ore of the Sudbury district, Ontario, and the metals in the finished alloy are in approximately the same proportion to one another as when found in nature. A typical analysis of the matte shows 67 per cent of nickel, 25 per cent of copper and 5 per cent of other metals, principally iron, manganese and silicon.

Mr. Corse indicated the principal uses of Monel metal in the automobile industry. Its silvery-white color, resistance to wear and the ease with which it is polished have made it a valuable material for door and brake handles, and for various dash trimmings. It has also been used satisfactorily in exhaust valves, spark-plug electrodes, and in float and needle valves for carburetors.

Ann Arbor Excursion

One of the outstanding features of the Detroit meeting was the day spent at Ann Arbor as the guests of the University of Michigan. The trip was made from Detroit in special electric cars which arrived at Ann Arbor about the middle of the forenoon. The remainder of the morning was occupied in the inspection of the laboratories and buildings of the university. A pleasant half hour was spent in Hill auditorium, where Prof. Earl R. Moore gave an excellent organ recital. Luncheon was served in the Michigan Union building, which is a magnificent clubhouse erected on the campus by student and alumni organizations. President M. L. Burton of the university, in a short talk after the luncheon, emphasized the value of the present dual system of education and declared that the tax-supported universities of the West should receive the same recognition accorded the privately-endowed institutions of the East.

Some Chemical Engineering Ideals

Dr. David Wesson, in his presidential address, stressed the important work with which the Institute is connected and indicated the possibilities for future accomplishments. Dr. Wesson chose for his subject "Some Chemical Engineering Ideals" and said, in part, as follows:

"Painted on the wall of the library of the National

HILL AUDITORIUM AT ANN ARBOR

Engineering Societies' Building in New York is the following definition:

> Engineering — the art of organizing and directing men and controlling the forces and materials of nature for the benefit of the human race.

"This definition is a very broad one and seems particularly adapted to defining the activities of the chemical engineers. It is a definition which arouses pride in our profession, for it indicates that the object of our profession is service—service for the benefit of our fellow beings.

"A glance through the list of members of our Institute will show that they are engaged in producing thousands of products which go to improve living conditions and at the same time provide means of earning a livelihood for multitudes. As an example, take the cottonseed oil industry alone. I mention it because it is the one with which I am most familiar. It gives employment in this country to 20,000 factory hands and 5,000 officers and salaried men, and all based on chemical engineering in developing the oil of a once despised waste product into valuable human food.

"Similar results are happening daily in other industries where the chemical engineer has had the opportunity to apply his knowledge. We see them in the field of metallurgy, fuel, mineral oils, tar, coloring matters and dyes, fiber products and paper, alkali acids and salts, glass and ceramics, building materials, paints, varnishes, india rubber, leather, glue, fertilizers, sugars and starches, foods and all sorts of organic products, photographic materials and explosives.

"The choice of the automobile as the keynote for the papers at this meeting is a particularly happy one. It is hard to conceive of any human production which embodies so many materials in its make-up as does this distance-destroying instrument of transportation. The papers read at this meeting will point out fully the part which the chemical engineer plays in making possible this modern means of travel.

"The automobile might well be taken as a symbol of the Institute. The industry started in a small way, and in twenty years has grown to world-wide importance. In the same way our Institute, starting modestly thirteen years ago, is rapidly growing into a national factor of economic and industrial importance.

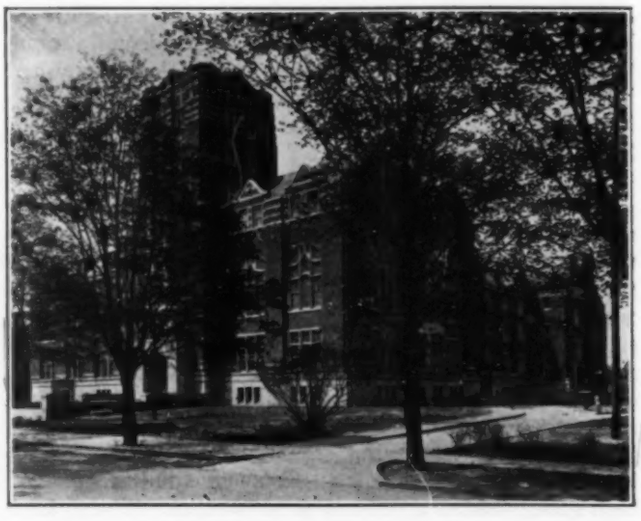
"The first automobiles were built for pleasure vehicles, and the industry was built up chiefly along the line of replacing the horse-drawn carriage. Now we see motor trucks displacing the dray and delivery wagon and competing with the railroad in the moving of merchandise. In the same way the Institute started out largely on an excursion, if not a joy-ride basis, but the responsibilities of the world war and the difficult reconstruction period which we are passing through have brought home to us all the idea that the Institute fulfills its highest ideals when it is rendering service to the profession and taking its part in national activities."

Chemistry of Road Building

The relation of the chemical engineer to highway engineering was the subject of an instructive lecture by Prof. A. H. Blanchard of the University of Michigan. He declared that the status of the chemistry of highway materials is in a chaotic condition notwithstanding the fact that some work has been accomplished by federal, state and municipal laboratories. There is a promising field for the chemical engineer who can co-operate with the highway engineer in studying the physical and chemical properties of highway materials. The application of tar on asphaltum is an example of the faulty use of materials due to lack of knowledge of the properties of the two constituents. On the other hand, certain combinations of these materials have been successfully applied, but the need here is for the chemical engineer to supply the explanation. Before these combinations can be bought on specifications the chemist must devise more satisfactory tests and methods of analysis.

Problems in Non-Ferrous Metallurgy

J. H. Ransom of the Michigan Smelting & Refining Co. read a paper entitled "Some Problems in Non-Ferrous Metallurgy." He laid emphasis on the fact that commercial metals are by no means 100 per cent pure, and the so-called "impurities," which as a matter of fact are mostly normal constituents, are likely to affect the resulting properties profoundly. In some cases alloying and remelting add to the total beyond that limited by safety, with the result that the metal becomes worthless. A probable case in point is the intercrystalline brittleness of lead, due to impurities segregated between the metallic crystalline grains. A



MICHIGAN UNION BUILDING

recently studied alloy of copper with about 15 per cent of nickel is also prone to this defect.

Minute amounts of unusual constituents often have a wholly disproportionate influence on the color, luster or "set" of an ingot, with a corresponding effect on its market value; inherently the metal may be undamaged. This effect had been studied carefully by the speaker, who concludes that changes in surface colors and other physical properties caused by a single additional element are usually characteristic and easily recognized. A combination of two or more impurities often causes greater perturbations than the same quantity of a single one, but in a few cases it was found that one addition counteracted a previous one. In general non-metals are more harmful than metals.

The Motor Fuel Problem

Prof. E. H. Leslie had prepared an exhaustive treatise on "The Motor Fuel Situation," but because of limited time, the paper was read only by title. Some of its salient features are reproduced here, however, as being of general interest.

"The motor fuel problem is one of the great problems of the present day. The solution demands readjustment and development in the petroleum and related industries, and in the automotive industries. Many of the problems are distinctly within the province of the chemical engineer.

"The consumption of gasoline is now nearly five billion gallons annually, and may be expected to increase to seven billion gallons. The United States produces two-thirds of the world's crude oil, but uses four-fifths of it. Our reserve supply below ground is 5,800,000,000 bbl., which, at a rate of production equal to that of 1920, would last only thirteen years. We are now dependent upon foreign crude oils, and are importing more crude oil than our combined exports of petroleum and its products.

"We cannot expect a further rapid expansion of the natural gas gasoline industry, nor can the distillation range of gasoline be further materially increased. Chemical research must point the way toward success in utilization of the heavier distillates as motor fuels.

"The most important single technical problem is the cracking of the heavier 40 to 50 per cent of petroleum, known as fuel oil or residuum. Processes now in use handle only the middle distillates.

"The use of aromatic distillates as fuel will never be of great consequence. Development of an alcohol industry based on wood as a raw material, and of a shale-oil industry, may be expected. Both are tremendous undertakings, and should not be expected to develop rapidly.

Critical Study of Boiling Points

Prof. E. M. Baker reported the results of some of the work growing out of the investigations of evaporator design which are being conducted in the laboratories of the University of Michigan. These investigations have emphasized the importance of a knowledge of the boiling points of solutions under reduced pressures. Mr. Baker and his associates have developed an apparatus capable of maintaining a reduced pressure constant at within 0.1 to 0.2 mm., and with this apparatus it has been possible to increase the accuracy of the boiling-point determinations to a greater degree than is required for any technical purpose.

They have made a critical study of boiling-point data and have found a general law which apparently holds rigidly for both concentrated and dilute solutions of all types, provided these solutions are not saturated and provided the dissolved substance does not itself exert an appreciable vapor pressure. This law is expressed by the equation $K = \frac{t_1 - t_2}{\theta_1 - \theta_2}$ where t_1 is the temperature at which a certain solution would boil at some pressure p_1, and θ_1 is the temperature at which water would boil at this same pressure. Likewise, t_2 and θ_2 are respectively the temperatures at which the same solution and water would boil at a different pressure, p_2. K is a constant for any given solution. Graphically, if the temperature of the solution is plotted as ordinates and the temperature at which water boils under the same pressure is plotted as abscissæ, the points for each solution will be on a straight line. This line represents the data for each solution more closely than any other smooth curve that can be drawn.

To illustrate how the law may be of assistance to the engineer concerned with evaporation and similar problems, we may assume that the temperatures at which a given solution will boil at two different pressures are known. Then the rule can be used to interpolate or extrapolate these data to other pressures, and the results will be as accurate as the original determinations. Thus the labor of investigating the boiling points of solutions under various pressures will be materially shortened.

The second paper, by Prof. Baker and V. H. Waite, presented the results of a critical study of the values given in the literature for the boiling points of calcium chloride solutions, supplemented by determinations using the law discussed in the previous paper.

Synthetic Ammonia Plants

The German and American synthetic ammonia plants were compared in an able manner by R. S. Tour, chemical engineer for the Nitrate Division of the Ordnance Department. The speaker was a member of the U. S. Fixed Nitrogen Commission, which inspected the German installations during the summer of 1919, and his paper showed the results of a very thorough investigation. The German plants studied were those at Oppau and Merseburg. Both were designed and built by the Badische Anilin und Soda Fabrik; the Oppau plant had a rated annual capacity of 100,000 metric tons of ammonia and the capacity of the Merseburg plant was 200,000 tons per year. The American plant at Sheffield, Ala., was rated at 10,000 short tons of ammonia.

The methods of operation and the types of equipment were compared by Mr. Tour, who also explained the details of the manufacture of the hydrogen and nitrogen required for the synthesis. The many interesting engineering applications need not be described here, since the complete paper will be published in a later issue of this magazine.

Costs of Production

The consideration of costs has an important bearing on the synthetic process. The investment in the Oppau plant figured on the actual pre-war cost was estimated at $270 per annual short ton of ammonia capacity or, roughly, $100,000 per daily ton. The Merseburg plant, started during 1916, cost at least 50

per cent more, and by 1918 the costs of its construction had increased 150 per cent over the 1914 figure. (Investment per annual short ton of ammonia: 1914, $270; 1916, $400; 1918, $700.)

The total cost of producing ammonia at the Oppau plant in 1914 was estimated to be 5.364 cents per pound. This figure was made up of the following items:

	Per Short Ton
Labor and operating	$10.27
Fuel	18.00
Plant upkeep	43.66
General works expense	10.80
Fixed charges (interest, insurance, etc.)	24.55
Total cost per ton	$107.28

Total cost per pound, $0.05364

Viewpoints on the Nitrogen Situation

In summarizing the nitrogen situation Mr. Tour said:

"The true aspects of the problem are beclouded by the difference in viewpoint of those following or aiding its development. The research chemist realizes that the chemical problems are of the simplest nature except for the final step of the catalysis of hydrogen and nitrogen to synthesize ammonia. The designing engineer, on the other hand, feels that the development of a catalyst is a specific laboratory problem with which the research chemist is properly equipped to cope, but that the design of dependable equipment to operate at high pressures with temperatures at times approaching a red heat and with gases or liquids sometimes corrosive on the materials of construction is the really serious obstacle to success. The industrial interests have still another viewpoint; while appreciating only to a small extent the problems of the research chemist, the designing engineer and the operating chemical engineer, they rightfully feel that the success of these men is for them a failure if the resulting investment, fixed charges and operating expenses make the cost of the product prohibitive.

"The successful development of the synthetic ammonia process can be attained only by a full appreciation of all of these viewpoints."

Resolution on Alcohol

The last business session of the convention was held on Thursday, June 23. Prof. A. H. White pointed out the imminent danger to the alcohol industry contained in certain proposed legislation and he introduced a resolution to Congress calling attention to the legitimate needs of the chemical industries and favoring proper legislation for industrial alcohol. This was passed unanimously.

Student Membership Approved

The Council of the Institute, after a consideration of the question of student membership, reported the following resolution:

Resolved, That the following amendment to the constitution be approved by the Council and recommended for adoption:

(1) That the Institute admit to its membership recognized chapters formed by students in chemical engineering at accepted institutions provided that at least one member of the faculty of the institution shall be an active member of the Institute and provided he shall act in an advisory capacity to such chapter.

(2) The constitution of each such student branch shall be approved by the Council.

(3) The members of such chapters shall receive the publications of the Institute and pay therefor such sum as the Council may determine.

(4) Members of the student chapters shall have the privilege of attending all meetings of the Institute.

Following a brief discussion by Professors White and Smith, the resolution was approved and referred to a committee for final drafting.

Nickel-Chromium Alloys and Heat-Treating

W. A. Gatward discussed the application of nickel-chromium alloys to the heat-treatment of steel. He described the four general methods of heat-treating—viz., (1) annealing of steel parts, (2) malleableizing of cast iron, (3) heating for hardening and (4) carbonization or case-hardening. The application of nickel-chromium alloys in heat-treating furnaces was formerly carried on only on an experimental scale or for the production of small and expensive tools and parts. During the war a number of large installations were made by munition manufacturers and since then there has been a promising development in this field. It was claimed that electrical heating can compete with the fuel-fired furnace on a purely cost basis, but the strongest arguments in its favor are the improved working conditions and the higher grade product resulting from more carefully controlled temperatures.

Aëronautic Developments

An informal talk on aëronautics was given by W. B. Stout. He discussed the recent developments in the aircraft industry, particularly the new all-metal type of plane which has largely been developed since the armistice.

The principal disadvantages of the wooden plane are the great waste in the selection of the spruce, the difficulty with which the wood can be tested, and finally the tendency of the plane to deteriorate due to the "letting up" of the glue and other causes. The metal plane, on the other hand, is constructed of material of very definite properties which can therefore be used with accuracy and precision.

Other Papers

Then followed two of the most interesting papers of the meeting. O. C. Berry of the Wheeler-Schebler Carburetor Co. spoke on the subject of "More Miles Per Gallon," and W. G. Nelson of Morgan & Wright discussed the determining factors in the life of a pneumatic tire. Both articles are to be published in early issues of this magazine.

Prof. James R. Withrow exhibited a new spray nozzle which was claimed to be very satisfactory for acid work. It was made of a high-silicon iron and is capable of giving a fine spray over a long period of operation.

A paper by Ludwig A. Thiele on the "Evolution of the Glue Industry and Grease Extraction" was read by title.

Convention Banquet

The closing event of the Institute's meeting in Detroit was the banquet at the Hotel Statler on Thursday evening. Following the bounteous repast and delightful musical entertainment, Toastmaster Alfred H. White called on Dr. Olsen, who spoke of some of the recent revelations of science. Responses were also given by Henry M. Leland, the father of the automobile industry, and Chester M. Culver of the Detroit Employers' Association. And finally the benediction was pronounced by President David Wesson in his pleasing and characteristic way and the convention adjourned until its winter meeting in Baltimore next December.

The Chemical Schedule of the Fordney Permanent Tariff Bill

An Analysis of the Proposed Provisions Affecting the Chemical Industries —Home Valuation of Imports and Restrictive Control of Dyes— Comparison of Rates in Previous Tariff Acts

THE Fordney bill for the revision of the permanent tariff, which was reported to the House of Representatives on June 29, represents the basis of what is perhaps the most important legislation to be passed by the present Congress. Its far-reaching effect on the future of industry and trade entitles it to the most serious consideration of all who are interested in our economic developments. The measure, framed along the well-known protective-tariff lines of the party in power, is the result of more than six months' work on the part of the Ways and Means Committee. It contains a great many unusual and untried provisions which make it difficult to compare it with previous tariff legislation or to render an accurate judgment on its probable operation.

The new tariff bill must be regarded as still in an experimental and tentative stage, for before its final enactment it will be the subject of many hours of heated debate and discussion, of political maneuvering and compromise. Some amendments will be accepted from the floor of the House, a more or less complete revision will probably be made by the Senate Finance Committee, and when, perhaps six months from now, it is signed by the President and finally becomes a law, it may bear but slight resemblance to its present form.

Home Valuation of Imports

One of the outstanding features of the proposed measure is the adoption of the domestic valuation of imports as the basis of assessing ad valorem duties. The change from the long-established use of the foreign market value has been made principally because of the instability of foreign exchange and the widely varying costs of production here and abroad. Section 402, which expresses "the legislative intention that duties ad valorem shall be assessed upon the fair market value of the merchandise *in the United States*" defines the dutiable value as:

> * * * the price on the date of exportation of the imported merchandise at which comparable and competitive products of the United States were ordinarily sold or freely offered for sale in the usual wholesale quantities and in the customary wrappings, coverings, and containers, whether holding liquids or solids, to all purchasers in the ordinary course of trade, including all costs, charges, and expenses, in the principal market or markets of the United States; . . .

In cases where this value cannot be ascertained to the satisfaction of the appraising officer, certain alternatives are provided, based either on the foreign value of the imported goods with certain additional charges or on the costs of production plus shipping and selling expenses, duties and commissions.

The change to home valuation will have the obvious effect of increasing the amount of revenue to be obtained from a given ad valorem rate of duty, so for that reason a substantial increase in protection has been effected by an apparently slight advance in the ad valorem rates.

The Fordney bill presents many other innovations in tariff legislation; a new scheme has been adopted for numbering the various schedules and the paragraphs within the schedules. There have been many changes in classification and phraseology and the administrative sections contain a number of new provisions giving the President the power, under circumstances warranted by the trade of the United States, to impose retaliatory duties or to adjust the rates along the principles of a bargaining tariff.

Rates in the Chemical Schedule

A critical examination of Schedule 1—Chemicals, Oils, and Paints—reveals comparatively few ad valorem duties higher than the general level of 25 per cent. The principal exceptions are in the cases of products of industries which have developed since the outbreak of the war, such for example as coal-tar dyes and medicinals, hydrosulphites and sulphoxylates, synthetic organic chemicals, perfumery and toilet articles, and the products derived from acetylene and other hydrocarbon gases. The general rate of 25 per cent ad valorem is carried by the all-inclusive paragraph 5, under the general provisions of which have been included hundreds, if not thousands, of "chemical and medicinal compounds, preparations, mixtures and salts, not specially provided for." This rate is at least double the basic duty of 15 per cent on the foreign market value provided by the present law, and is a slight increase over the general level of the Payne-Aldrich tariff of 1909. Because of the change in the basis of valuation it is difficult to compare the rates between this and the earlier protective tariff, but of 100 duties in Schedule 1, 47 were found to be the same as in the Payne law, 27 are higher and 26 are lower. The rates in the Fordney bill on the principal chemicals are compared with those in the two preceding tariff laws in the accompanying table.

Control of Dye Imports

By far the most significant feature of the chemical schedule is the special protection accorded to dyes and intermediates, pharmaceuticals and other products derived from coal tar. Not only are higher duties imposed, but for a period of three years these products cannot be imported unless the importer complies with certain very specific conditions. Dyes and other coal-tar chemicals which are manufactured in the United States and are obtainable on reasonable terms as to quality, price and delivery cannot be imported under any conditions. Products not being made here or for which the domestic supply fails to meet the requirements of satisfactory quality, price or delivery can be brought into the United States only by an importer registered with the United States Tariff Commission, and the total importation must not exceed a six months' supply for the actual consumer of the dyestuff.

This restrictive control of imports follows along lines somewhat similar to the "selective embargo" proposed

in the Senate during the last session as a substitute for the licensing scheme of the original Longworth bill. The section giving the Tariff Commission the power to determine reasonable terms as to quality, price and delivery is practically identical with the corresponding sections of the earlier bill. The new provisions, however, definitely establish the procedure by which the United States Tariff Commission is to administer the control. All of the articles in the paragraphs covering intermediates and finished coal-tar products are to be divided into two classes. Class A, which includes the non-importable products, is published in the form of a list, and this list may be revised, from time to time, at the discretion of the commission as the result of its investigations or following hearing of complaints. The commission is also required to publish a list of persons who have registered with the commission and are therefore permitted to import dyes under the above regulations.

The limitation in regard to the quantity of imports is accomplished by requiring the importer (or the actual consumer if the importer is acting as an agent) to furnish the collector of customs with an affidavit stating that "the quantity to be delivered will not place him in possession or control of more than a six months' supply." Exception is made in the case of those goods which are sold in small packages through the retail trade, for which it would obviously be impossible to ascertain consumption during any limited period. Other sections of the dye schedule provide for the transfer to the Tariff Commission of the former War Trade Board Section, and also establish penalties for failure to comply with the regulations for administering the act.

Objections will probably be raised to this or any other form of restrictive control, on the familiar grounds of "less government in business," but the supporters of the bill point out the important relation of the dye industry to the national defense, and as a proof of their contention that a high tariff alone is inadequate, they cite the example set by England and France, which have already protected their dye industries by embargoes or similar measures. The coal-tar provisions include, in addition to dyes and intermediates, such materials as color lakes, pharmaceuticals, photographic chemicals, synthetic perfumes and flavoring materials, synthetic tanning materials, synthetic phenolic resins, explosives and all other products "when obtained, derived or manufactured in whole or in part" from coal tar.

RATES OF DUTY ON IMPORTANT CHEMICALS IN FORDNEY BILL COMPARED WITH THOSE IN PAYNE-ALDRICH AND UNDERWOOD-SIMMONS TARIFF LAWS

Specific duties on per pound basis unless otherwise noted

Commodity	Payne-Aldrich Act of 1909	Underwood-Simmons Act of 1913	Fordney Bill of 1921
Acetic acid, 65% and less	¼c.	Free	¼c.
Acetic acid, over 65%	¼c.	Free	2c.
Acetic anhydride	2½c.	2½c.	8c.
Boric acid	3c.	¼c.	2c.
Chloroacetic acid	25% n.s.p.f.*	15% n.s.p.f.	5c.
Citric acid	7c.	5c.	10c.
Lactic acid	2c.–3c.†	1¼c.	1¼c.–3c.†
Tannic acid and tannin	35c.	5c.	4c.–20c.†
Tartaric acid	3c.	3½c.	6c.
Arsenic and arsenious acids	Free	Free	25%
Formic acid	25% n.s.p.f.	1½c.	25%
Gallic acid	8c.	6c.	25%
Oleic acid	25% n.s.p.f.	15% n.s.p.f.	25%
Oxalic acid	2c.	1½c.	25%
Phosphoric acid	Free	Free	25%
Pyrogallic acid	25% n.s.p.f.	12c.	25%
Stearic acid	25% n.s.p.f.	15% n.s.p.f.	25%
Acetaldehyde	25% n.s.p.f.	15% n.s.p.f.	6c. + 30%
Acetone	25% n.s.p.f.	1c. per lb.	25%
Alcohol, amyl	¼c.	¼c.	6c.
Alcohol, butyl	25% n.s.p.f.	¼c.	6c.
Alcohol, isopropyl and fusel oil	¼c.	¼c.	6c.
Alcohol, methyl	25% n.s.p.f.	Free	15c. per gal.
Alcohol, ethyl	$2.60 per pr. gal.	$2.60 per pr. gal.	15c. per gal.
Aluminum hydroxide	1/10–⅛c.	15%	¼c.
Alum	¼–½c.†	15%	1/10–½c.†
Ammonium carbonate	1½c.	¼c.	1½c.
Ammonium chloride	¼c.	¼c.	1½c.
Ammonium nitrate	25% n.s.p.f.	Free	25%
Ammonium sulphate	Free	Free	¼c.
Anhydrous ammonia	5c.	2½c.	2½c.
Antimony oxide	1½c.	25%	2c.
Tartar emetic	25% n.s.p.f.	15% n.s.p.f.	5c.
Argols and wine lees	5%	5%	5%
Cream of tartar	5c.	2½c.	5c.
Rochelle salts	3c.	2½c.	5c.
Balsams, crude	Free	10%	10%
Balsams, refined	¼c. + 10%	15%	
Barium carbonate	25% n.s.p.f.	15%	1c.
Barium chloride	25% n.s.p.f.	¼c.	1½c.
Barium dioxide	25% n.s.p.f.	1½c.	4c.
Barium nitrate	25% n.s.p.f.	15% n.s.p.f.	2c.
Bleaching powder	¼c.	1/10c.	¼c.
Caffeine	25% n.s.p.f.	$1	$1.50
Tea waste	.....	1c.	1c.
Calcium carbide	25% n.s.p.f.	Free	1c.
Calomel	35%	15%	30%
Carbon tetrachloride	25% n.s.p.f.	1c.	2½c.
Chloroform	10c.	2c.	8c.
Chalk, precipitated	1c.	25%	15%
Chicle, crude	10c.	15c.	15c.
Chicle, refined		20c.	20c.
Chloral hydrate	25% n.s.p.f.	25%	25%
Terpin hydrate	25% n.s.p.f.	25%	25%
Thymol	25% n.s.p.f.	25%	25%
Urea	25% n.s.p.f.	25%	25%
Glycerophosphoric acid	25% n.s.p.f.	25%	25%
Coal-tar intermediates	Free	10%	7c. + 30%
Coal-tar dyes, medicinals, etc.	30%	30%	7c. + 35%
Cobalt oxide	25c.	10c.	20c.
Collodion	40c.	15%	35c.
Pyroxylin, unfinished	45c.	25%	40c.
Pyroxylin, finished	65c. + 30%	40%	65c. + 25%
Drugs, crude	Free	Free	Free
Drugs, advanced	¼c. + 10%	10%	10%

Commodity	Payne-Aldrich Act of 1909	Underwood-Simmons Act of 1913	Fordney Bill of 1921
Buchu leaves	¼c. + 10%	10c.	10c.
Coca leaves	¼c.	10c.	10c.
Gentian	¼c. + 10%	¼c.	¼c.
Licorice root	Free	¼c.	¼c.
Sarsaparilla root	¼c. + 10%	1c.	1c.
Belladonna	¼c. + 10%	10%	25%
Digitalis	¼c. + 10%	10%	25%
Henbane	¼c. + 10%	10%	25%
Stramonium	¼c. + 10%	10%	25%
Ergot	Free	10c.	10c.
Diethyl sulphate	25% n.s.p.f.	15% n.s.p.f.	25%
Dimethyl sulphate	25% n.s.p.f.	15% n.s.p.f.	25%
Ethyl acetate	25% n.s.p.f.	5c.	4c.
Ethyl chloride	30%	20%	15c.
Ethyl ether	8c.	4c.	6c.
Extracts for dyeing and tanning	1c. + 10%	¼c.	12½%
Flavoring extracts, non-alcoholic	.....	20%	25%
Formaldehyde	25% n.s.p.f.	1c.	25%
Hexamethylenetetramine	25% n.s.p.f.	15% n.s.p.f.	25%
Glycerine, crude	1c.	1c.	1c.
Glycerine, refined	3c.	2c.	3c.
Ink and ink powders	25%	15%	20%
Iodine, resublimed	20c.	Free	20c.
Lead acetate, white	3c.	1½c.	3½c.
Lead acetate, brown	2c.	1c.	2½c.
Lead nitrate	2½c.	1½c.	2½c.
Lime, citrate of	Free	1c.	2½c.
Magnesium carbonate	3c.	1½c.	1½c.
Magnesium chloride	25% n.s.p.f.	15% n.s.p.f.	¼c.
Magnesium sulphate	1/5c.	1/10c.	¼c.
Magnesium oxide	7c.	3½c.	7c.
Magnesite, calcined	Free	Free	¼c.
Magnesite, crude	Free	Free	¼c.
Menthol	25% n.s.p.f.	50c.	25%
Camphor, crude	Free	1c.	25%
Camphor, refined	6c.	5c.	
Oils, animal, n.s.p.f.	25%	15%	20%
Oils, fish, n.s.p.f.	8c. per gal.	3c. per gal.	20%
Oils, expressed, n.s.p.f.	25%	15%	25%
Castor oil	35c. per gal.	12c. per gal.	4½c.
Cottonseed oil	Free	Free	2c.
Coconut oil, crude	Free	Free	2c.
Soya-bean oil	Free	Free	2c.
Hempseed oil	10c. per gal.	3c. per gal.	1½c.
Linseed oil	15c. per gal.	10c. per gal.	2½c.
Olive oil, less than 5 gal.	50c. per gal.	30c. per gal.	7½c.
Olive oil, more than 5 gal.	40c. per gal.	20c. per gal.	6½c.
Peanut oil	Free	6c. per gal.	2½c.
Poppyseed oil	15c. per gal.	6c. per gal.	2c.
Rapeseed oil	Free	6c. per gal.	1½c
Turkey-red oils	15–30c. per gal.	25%	25%
Oils, essential, n.s.p.f.	25%	20%	25%
Orange and lemon oils	Free	10%	20%
Peppermint oil	25c.	25c.	25c.
Opium, crude	$1.50	$3	$3
Opium, manufactured	$2	$4	$4
Morphine	$1.50 per oz.	$3 per oz.	$3 per oz.
Cocaine	$1.50 per oz.	$2 per oz.	$2 per oz.
Perfume materials, synthetic	Free	20%	35%
Perfumery, alcholic	60c. + 50%	40c. + 60%	40c. + 60%
Perfumery, non-alcoholic	60%	60%	60%
Floral waters	20%	20%	20%
Bay rum	$1.75 per pr. gal.	$1.75 per pr. gal.	40c. + 60%
Paris green	15%	Free	15%

Commodity	Payne-Aldrich Act of 1909	Underwood-Simmons Act of 1913	Fordney Bill of 1921
Phosphorus	18c.	Free	15c.
Paints, artists'	30%	20%	25c.
Paints and pigments, n.s.p.f.	30%	20%	25%
Barytes, crude	$1.50 per ton	15%	$4 per ton
Barytes, ground	$5.25 per ton	20%	$7.50 per ton
Prussian blue	8c.	20%	12c.
Ultramarine	3c.	15%	3c.
Bone black	25%	15%	20%
Chrome colors	4½c.	20%	25%
Gas black	25%	15%	20%
Litharge	2½c.	25%	2½c.
Orange mineral	3½c.	25%	2½c.
Red lead	2½c.	25%	2½c.
White lead	2½c.	25%	2½c.
Ochers, siennas, umbers	½–¾c.	5%	½–¾c.
Satin white	½c.	20%	½c.
Spirit varnishes, denat'd	35c. per gal. + 35%	10%	25%
Spirit varnishes, not denat'd	$1.32 per gal + 35%	$1.32 per gal. + 35%	$2.20 per gal.
Vermilion reds	10c.	15%	10c.
Zinc oxides	1c.	10%	1½c.
Zinc oxides, in oil	1½	15%	2c.
Lithopone	1½c.	15%	1½c.
Potassium chromate	2½c.	1c.	2½c.
Potassium dichromate	2½c.	1c.	2½c.+ 15%
Pottassium chlorate	2c.	½c.	2c + 15%
Potassium ferricyanide	8c.	2c.	7c. + 15%
Potassium ferrocyanide	4c.	1½c.	4c. + 15%
Potassium iodide	25c.	15c.	25c.+ 15%
Potassium bicarbonate	25% n.s.p.f.	½c.	40%
Potassium bromide	25% n.s.p.f.	15% n.s.p.f.	40%
Potassium carbonate	Free	Free	40%
Potassium hydroxide	1c.	Free	40%
Potassium nitrate	½c.	.35c.	40%
Potassium permanganate	25% n.s.p.f.	1c.	40%
Santonin	50c.	Free	75c.
Soap, Castile	1½c.	10%	15%
Soap, toilet	50%	30%	30%
Soap, all others	20%	5%	20%
Sodium arsenate	1c.	Free	1c.
Sodium bicarbonate	1c.	½c.	½c.
Sodium borate	2c.	½c.	½c.
Sodium bromide	25% n.s.p.f.	15% n.s.p.f.	25%
Sodium carbonates	½c.	Free or ½c.	½c.
Sodium chlorate	1½c.	½c.	1½c.
Sodium chloride, bags	.11c.	Free	.11c.
Sodium chloride, bulk	.07c.	Free	.07c.
Sodium chromates	1½c.	½c.	1½c.
Sodium formate	25% n.s.p.f.	15% n.s.p.f.	25%
Sodium ferricyanide	2c.	½c.	2c.
Sodium hydroxide	½c	½c.	½c.
Sodium nitrite	2c.	½c.	3c.
Sodium phosphate	½c.	½c.	½c.
Sodium sulphate, crystals	.05c.	Free	.05c.
Sodium sulphate, anhydrous	.05c.	Free	.10c.
Sodium sulphide	½–½c.†	½c.	½–½c.†
Sodium silicate	½c.	Free	½
Sodium sulphites	½c.	½c.	½
Sodium hydrosulphite	25% n.s.p.f.	15% n.s.p.f.	35%
Sulphoxylates	25% n.s.p.f.	15% n.s.p.f.	35%
Starch, potato	1½c.	½c.	1½c.
Starch, all other	½c.	½c.	½c.
Dextrine, potato	1½c.	1½c	1½c.
Dextrine, all other	1½c.	½c.	1½c.
Strontium salts	25% n.s.p.f.	15% n.s.p.f.	25%
Strychnine	15c. per oz.	Free	15c. per oz.
Thorium nitrate	40%	25%	25%
Tin compounds	25% n.s.p.f.	10%	20%
Titanium compounds	25% n.s.p.f.	15% n.s.p.f.	25%
Vanilla beans	.....	30c.	30c.
Tonka beans	Free	25c.	25c.
Zinc chloride	½c.	½c.	1 1/5c.
Zinc sulphate	½c.	½c.	½c.
Zinc sulphide	1½c.	15%	1½c.
Petroleum, crude	Free	Free	35c per bbl.
Fuel oil	Free	Free	25c. per bbl
CHEMICALS ON THE FREE LIST			
Chromic acid	2c.	Free	Free
Hydrofluoric acid	Free	Free	Free
Hydrochloric acid	Free	Free	Free
Nitric acid	Free	Free	Free
Cinchona bark	Free	Free	Free
Azides and fulminates	20%	Free	Free
Calcium acetate	25% n.s.p.f.	Free	Free
Calcium chloride	25% n.s.p.f.	Free	Free
Calcium nitrate	25% n.s.p.f.	Free	Free
Calcium cyanamid	Free	Free	Free
Coal-tar crudes	Free	Free	Free
Copper sulphate	½c.	Free	Free
Copper acetate	Free	Free	Free
Crude drugs	Free	Free	Free
Enfleurage grease	Free	20%	Free
Floral essences	Free	20%	Free
Ferrous sulphate	.15c.	Free	Free
Iodine, crude	Free	Free	Free
Monazite sand	4c.	25%	Free
Oils, essential	Free	20%	Free
Potash salts, crude	Free	Free	2½c.‡
Potassium cyanide	12½%	Free	Free
Quinine	Free	Free	Free
Sodium cyanide	12½%	Free	Free
Sodium nitrate	Free	Free	Free
Sodium sulphate, crude	0.05c.	Free	Free
Sulphur	½c.	Free	Free
Pyrites	Free	Free	Free
Tapioca flour	Free	Free	Free
Sago flour	Free	Free	Free

* Not specially provided for.
† Depending on strength.
‡ For two years; 2c. for third, 1½c. for fourth, 1c. for fifth, thereafter free.

Fertilizer Materials Become Dutiable

For the first time in tariff history imported fertilizer materials are to be taxed. A duty of three-fifths of a cent per pound is imposed on ammonium sulphate, presumably to encourage the development of byproduct coke ovens and to protect the domestic industry from possible competition of Germany's nitrogen fixation plants. These plants, built under the stress of military necessity, are reported to have the capacity to produce almost double the entire world's pre-war requirements of ammonium sulphate. The development of the byproducts industry in our own country has reached the stage where it now supplies the domestic consumption, with a small exportable surplus, so it is not likely that the duty imposed will materially affect the ammonia trade. An additional factor of safety is the stabilizing influence of the competition with Chilean nitrate.

The Duty on Potash

The bill also provides a duty on crude potash salts, which will probably be felt somewhat more seriously, since, for the present at least, it will be necessary to import more than three-quarters of the country's requirements. The domestic producers, whose output in 1920 supplied only about one-fifth of our normal consumption, maintain that with the five years of protection afforded by this bill they can increase their production to the extent that the country will be practically independent of the German and Alsatian supplies. Whether or not this can be accomplished will depend to some extent upon the solution of the transportation problem, and possibly, in the case of the Searles Lake producers, to the development of a water route through the Panama Canal. The duty on potash salts is to be on a declining scale. Starting with a maximum of 2½c. per lb. of actual potash for the first two years, the duty is reduced to 2c. for the third year, 1½c. for the fourth, 1c. for the fifth, and thereafter the imports are to be free of duty. For a period of five years a compensating duty of 15 per cent ad valorem is added to the regular rates on the refined potassium salts included in paragraph 75 of the chemical schedule.

Other Industries Receiving Protection

Other industries to be recognized by the new tariff are barytes and barium chemicals, magnesite, crude botanical drugs, synthetic camphor, and hydrogenated, vulcanized and other chemically treated oils. Chemical manufacturers will be interested in knowing that pyrites is to remain on the free list. The duty of $4 per ton on crude barytes may be regarded as a compromise between the demands of the consumers along the Atlantic seaboard and those of the inland producers. With present freight rates the duty provided is not sufficient to permit the Missouri barytes to compete in the New York market, but it is questionable whether or not this could have been accomplished without giving undue advantage to the Georgian producers, who are more strategically located. Barium carbonate, chloride, dioxide and nitrate are given slightly higher rates than in previous tariffs in order to compensate for the duty on the raw material.

Another war mineral to become dutiable for the first time is magnesite, which is an essential material for

the manufacture of refractories and certain cements and stucco. Here too the fixing of the exact rate of duty involves the serious problem of transportation. The centers of production and consumption for this comparatively cheap material are separated by the width of the continent.

Crude Botanical Drugs and Synthetic Camphor Receive Preferential Treatment

When the late war cut off the supply of certain indispensable botanical drugs their cultivation was attempted in the United States, and, in certain instances, with conspicuous success. The most important of these products, belladonna, digitalis, stramonium and henbane, have been given preferential treatment in the drug provisions of the new tariff.

Tariff laws in the past have generally imposed a duty on camphor for the purpose of raising revenue. A slight differential has sometimes been allowed between the crude and refined camphor and this has resulted in developing some refining in this country. The bulk of our large requirements, however, is purchased from the Japanese monopoly in the form of crude camphor. An ad valorem duty of 25 per cent on all forms of camphor is imposed presumably to encourage the manufacture of synthetic camphor, since the development of this new industry is apparently the only way that this country can become independent of the great foreign monopoly.

Reclassification of Chemicals

Most of the changes in the phraseology of the new tariff law are those suggested by the Tariff Commission in its report on reclassification. For example, the duties on acetic, lactic and tannic acids are based on standards of strength in order to avoid the unsatisfactory operation of the single specific duties imposed by the present law. By combining all of the dyeing and tanning materials of vegetable origin in a single provision, the customs officials are relieved of the difficulties of separate classifications based on use. A more logical and scientific classification of the oil provisions separates the animal oils, the expressed vegetable oils and the essential oils, and new paragraphs have been added for sulphonated oils and soluble greases, for hydrogenated, vulcanized, chlorinated and other chemically treated oils, and for the mixtures and combinations of animal, vegetable, and mineral oils. Radical changes have been made in the provisions dealing with perfume materials and perfumery. The principal raw materials such as the flower oils and floral products, and musk and other animal perfumes, have been transferred to the free list, although under the present law these articles are taxed for revenue purposes. The synthetic perfumes derived from coal tar are included in the provision for coal-tar products; those derived from the essential oils and non-coal-tar sources are given a protective duty of 35 per cent ad valorem. A more significant reclassification is found in the provision for mixtures and combinations of the various perfumery materials, which become dutiable at the comparatively high rate of 40c. per lb. and 40 per cent ad valorem. By imposing this higher duty the Congress evidently intended to develop the manufacture of perfumery from the primary raw materials and to prevent the practical evasion of the duties on finished perfumery by the importing of semi-finished and carefully compounded preparations.

The proposed duty of 35c. per bbl. on crude petroleum oil and 25c. on fuel oil is perhaps not to be regarded too seriously. Its transfer to the chemical schedule from the free list was accomplished at the last session of the committee and the corresponding correction had not been made in the printed copy of the reported bill. It is interesting to note, however, that gasoline, benzine, kerosene and other refined petroleum products remain on the free list, notwithstanding the duty on the raw material.

It has been possible here to comment upon only a few of the many features of the new tariff, but the importance of the measure merits the careful study of all who are interested in the development of our chemical industries.

Avoid Temperature Shocks in Heat-Treatment

The A.S.T.M. committee on heat-treatment of iron and steel submitted the following notes to the recent convention at Asbury Park, N. J., as covering helpful information:

The advantage of alloy steels over simple steels lies in the fact that they are more sensitive to heat-treatment and capable of giving higher properties when properly handled. The increased sensitiveness to treatment unfortunately is accompanied by a proportionate sensitiveness to failure during treatment, which requires greater care in all treatment operations and necessitates the elimination of abrupt changes in section. The following suggestions are made to overcome this difficulty:

1. Heavy solid alloy forgings should not be allowed to cool, but should immediately be put in an annealing furnace and normalized.

2. High nickel-chrome, chrome-vanadium or any other alloy steel bars and small forgings liable to shattering should be cooled slowly after rolling by burying in warm ashes or lime to retard the cooling. High carbon, even with a moderate alloy content, increases the risk of cracking.

3. A thorough annealing or normalizing above the upper critical point after rolling or forging eliminates much danger of later troubles due to cracks and strains and leaves the metal in a better condition to secure the maximum effect of the quench.

4. Annealing only does not develop high physical properties, but leaves the metal soft, uniform and ductile. To break up forging and rolling structures which are detrimental the piece should be double annealed, first at 100 to 200 deg. F. above the critical range followed by an anneal slightly above the critical range.

5. In heating for either annealing or quenching, the piece should be slowly and uniformly brought to temperature, the rate depending on grade and section, especially through the brittle range, which is up to 800 deg. F.

6. For quenching, the piece should be uniformly heated above the critical range and introduced into the quenching medium with no delay after leaving the furnace.

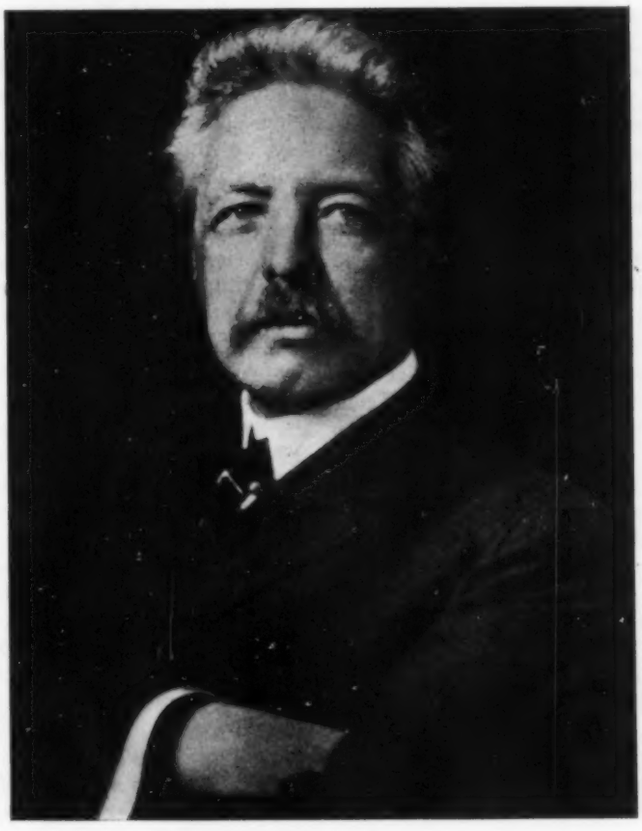
7. Quenching is the most drastic treatment operation, and therefore the most dangerous. Alloys or sections subject to water cracks should be quenched in circulating oil.

8. In drawing after quenching the piece must be slowly and uniformly heated to the proper temperature, but may be cooled slowly or rapidly as desired.

Albert Sauveur, Honorary Member of Steel Treaters

ALBERT SAUVEUR, professor of metallurgy at Harvard University, Officer of the French Academy, Elliott Cresson Medalist, was notified of his election to honorary membership in the American Society for Steel Treating on the occasion of his address before the Cleveland Section of that society on the "Dendritic Structure of Steel." In accepting the honor he honored the donors, who have thus added to their notables a leader in metallurgical thought and writing among technologists both here and abroad.

Coming to America fresh from the School of Mines at Liége, Belgium, Albert Sauveur matriculated in the Massachusetts Institute of Technology and received there the degree of Bachelor of Science in Mining and Metallurgy in 1889. Thereafter for eight years he served his novitiate as chemist and metallurgist—and in those days metallurgists were far more rare than chemists—for the Pennsylvania Steel Co. and the Illinois Steel Co.



ALBERT SAUVEUR

W. R. Walker, manager of the South Works of the latter company, asked young Sauveur to take up the microscopical examination of iron and steel, which had received some attention both in England and in France. There was an old microscope available, and he was given an empty room in the laboratory. While waiting for table, desks and other equipment, a barrel served as a metallographic bench, and diffused sunlight replaced a better illuminator. From this hurried beginning he created that early work which was destined to have such a wide influence on the manufacture and heat-treatment of steel. The first application of microscopic evidence was to throw light upon apparently unexplainable variations in the quality of steel rails. A close examination of metallic structure seemed so pregnant with possibilities that the subject has since been followed keenly by him, his interest never flagging, and as a result it is no exaggeration to say that he has done as much as any other man, if not more than any other man, to bring metallurgy to its present important place as a method of routine testing and fundamental research.

That early work at Chicago extended into an investigation on crystallization in steel, and some of his results were read before the 1893 Chicago meeting of the American Institute of Mining Engineers. He had already set for himself the concrete problem, "What heat-treatment will best suit a given chemical composition so as to get a certain desirable structure, and with it certain other desirable physical properties?"—a problem which is as important now as then, and even yet capable of solution only in special cases.

This first contribution to the literature showed that Sauveur had already diagnosed the relative effect of temperature, degree of work, rate of cooling and chemical composition on grain size of steel products. He had devised and used a method of measuring grain size without the necessity of photographing the specimen, and constructed curves showing its relation to the tensile properties and ductility of bessemer rails. His paper clearly shows, and in a way which then was unique in technical literature, that the finishing temperature and size of section has a great effect on the structural heterogeneity in a steel rail.

Such pioneer work on the industrial applications of metallography may be appraised only in the light of the amount of information regarding the science then available. To illustrate: At the same meeting, Osmond, the French savant, presented a paper on "Microscopic Metallography" covering such subjects as methods of illumination (now considered very elementary), and presenting micrographs of typical commercial steels, concluding briefly that "it is difficult to offer, even hypothetically, a satisfactory solution" of the reasons for difference in structures.

A worker of the Sauveur type could not long dodge the question, "What causes hardening?" and in 1896 he wrote another paper for the American Institute of Mining Engineers on "Microstructure of Steel and the Current Theories of Hardening," which summarizes to that date the ideas of various metallurgists on the reason for the hardening of steel, and presents data of his own bearing upon the subject. This provoked such a discussion both in America and abroad that the paper marks an epoch in the history of heat-treatment. It was critically discussed by such men as Howe, Arnold, LeChatelier and Osmond, the latter presenting in a long contribution one of his first contributions to scientific information on the allotropy of iron, a new conception which has been widely accepted and has had such a strong influence on the theory and practice of heat-treatment of iron and steel.

At that time austenite had not been established as the solid solution of carbon in gamma iron—in fact martensite was thought to be the constituent stable at a high temperature, and on cooling it first precipitated excess ferrite (in low-carbon steels) and finally the residual portions transformed into pearlite. After marshaling the main evidences in favor of the various

theories of hardening he writes in this article: "Martensite is the constituent which confers hardness upon suddenly cooled steel. If we knew its composition, the mist which now surrounds the phenomenon of hardening would be cleared away." With a truly remarkable clearness of judgment he presents his own conclusion from the evidence—namely, that martensite is carbon dissolved in iron—and proposes the idea that the hardness of martensite is essentially due to the distribution of carbide in the mass! This paper was written twenty-five years ago, and in his later writings Prof. Sauveur favors the view that hardness of martensite is due to beta iron with carbide in solution, yet does not the earlier conclusion remind one of the "critical dispersion" hypothesis of hardening lately supported by our friends the colloid chemists?

A Keen and Witty Expert Witness

As the senior member of the firm of Sauveur & Boylston, such keen insight has in later years brought him great repute as an expert in important patent litigation. Sauveur always goes straight to the heart of a matter, and is always able and ready to clear up difficult points in the minds of attorneys and judges. This, without losing patience with legal obtuseness, without forgetting to temper the caution of the trained expert with common sense. After all a lawyer is only a human being, and wit often brings a laughing understanding with even a metallurgist.

In 1899 he was called to Harvard University as instructor and was assistant professor in metallurgy and metallography from 1900 to 1905. He lectured on metallography at the Massachusetts Institute of Technology until 1903. Since 1905 he had been professor of metallurgy at Harvard. He found time to edit the *Metallographist* (1898-1903) and its successor the *Iron and Steel Magazine* from 1903 to 1906. The latter magazine in turn was merged with Chemical & Metallurgical Engineering, then called *Electrochemical and Metallurgical Industry*.

Naturally his publications have been many. He is best known to metallurgical students for his wholly admirable "Metallography and Heat-Treatment of Iron and Steel," published in 1912 and since passing through several editions. Its information is contained in simple language, written in a clear style, arranged in a very orderly manner and illustrated not only with well-choosen micrographs but with a number of very original graphic diagrams.

As a teacher he is beloved by his students for his fairness, never failing courtesy and his clear explanation of difficult points, his quick sense of humor and ready wit driving home each principle or detail to the pupil. Dignified, yet alert to discern the fallacy in an argument of student or associate, he is nevertheless able to set either one right without offending. Prof. Sauveur is always patient with errors of students and employees, and gives his orders chiefly by means of suggestions which nevertheless convey his desires, leaving no doubt in the mind of the hearer as to the importance of the work in hand.

Despite the many duties of his post at Harvard, he has always been generous with time and thought for the good of our Government and the profession. In 1917-19 he was metallurgist of the American Aviation Commission in France and later director of research for the Metallurgical Division, Air Service, A.E.F., stationed in Paris, France.

Large Production of Fullers Earth in 1920

The production of fullers earth in 1920, according to a statement made public by the United States Geological Survey, was 128,487 short tons, valued at $2,506,189, or $19.51 per ton. These amounts represent the largest output, the largest value and the largest average price ever recorded. The output was 21 per cent greater than in 1919; it was more than three times as great as in 1913 and nearly nineteen times as great as in 1895, the first year of production. The value in 1920 was 25 per cent greater than that in 1919, nearly seven times as great as that in 1913, and sixty times as great as that in 1895. The average price per ton in 1920 increased only 4 per cent over that in 1919.

Fullers earth was produced in eight states in 1920; named in the order of their rank in output they were Florida, Georgia, Texas, Alabama, Nevada, Arkansas, California and Massachusetts. Promising deposits of fullers earth have been discovered also in Pennsylvania and Virginia. The Southern States reported 99 per cent of the output, Florida alone reporting about 85 per cent of the total.

The imports of fullers earth, which for many years constituted the entire source of supply, also increased in quantity and value in 1920. During the war these imports naturally decreased in quantity, and with the cessation of hostilities they just as naturally increased. The imports in 1918 were about 50 per cent of the maximum (24,977 short tons in 1914); in 1920 they were 77 per cent of the maximum. During the war some refiners of edible oils and fats—by whom the imported fullers earth is probably used exclusively—were unable to obtain a sufficient supply of foreign earth and were compelled to adapt domestic earth to their needs, and it may be that imports of this material will never again be so essential to the American industry.

The imports of fullers earth in 1920 were 19,235 short tons, valued at $221,893, or $11.54 a ton. These amounts represent an increase of 39 per cent in quantity and of 17 per cent in value.

The average price at the markets of the country from which the material was imported decreased $2.13 a ton.

Production of Bauxite in 1920

According to figures collected by the United States Geological Survey, 521,308 long tons of bauxite, valued at $3,247,345, was produced in the United States in 1920, as compared with 376,566 long tons, valued at $2,201,747, in 1919.

The mines in Saline and Pulaski counties, Arkansas, produced 481,279 long tons, or 92 per cent of the total output in 1920. The production from these mines in 1919 was 333,490 long tons.

Georgia ranked second, Alabama third and Tennessee fourth in production, and the combined output of these three states was 40,029 long tons in 1920, as compared with 43,076 long tons in 1919. In Georgia the bauxite-producing counties, arranged in order of quantity produced, were Sumter, Wilkinson, Floyd, Randolph, Meriwether, Macon and Bartow. A number of the mines in Bartow and Wilkinson counties that were worked in former years have been abandoned, but new deposits in Randolph County were opened in 1920.

The bauxite imported in 1920, most of it from South America and France, amounted to 42,895 long tons, as compared with 6,082 long tons in 1919.

The Latent Heats of Fusion of Nickel and Monel Metal

Description of Apparatus and Manipulation for Precise Determinations of Specific Heat of Solid or Liquid Metals—Results Found Indicate That Formerly Published Figures Are in Error by 30 Per Cent

By WALTER P. WHITE

THE present paper deals with the two important metals nickel and copper. The work was done with considerable care; hence it is hoped that the results obtained will, besides being of value themselves, also prove useful as a check on other series of determinations in which these two metals are included.

Latent heat determinations of any sort above 1,000 deg. have not been numerous. The 1913 edition of Landolt and Börnstein contains latent heats of only four metals melting above 1,000 deg.—platinum, palladium, cast iron and copper—and none of these is really modern.

In 1918 Wüst, Meuthen and Durrer published[1] specific and latent heats, obtained by a very bold and interesting method, of numerous metals, including nickel, iron, cobalt, manganese, copper, gold and silver. This extensive research is thus our main source of knowledge of metallic latent heats above 1,000 deg.

The value for the latent heat of nickel obtained in the present work, 73 calories per gram, is very different from Wüst's value, 56 calories. There is evidently a large error somewhere; hence the probable error of the present work will be considered very carefully.

General Method

The method employed was the familiar one of heating the specimens of metal and then dropping them into a water calorimeter. Some special features of the particular arrangement used will be described at the end of this paper. The arrangements concerned in the temperature measurement in the furnace are of first importance, since this measurement presents the greatest uncertainties and therefore mainly determines the probable precision attained. The other errors, in weighing, in the dropping process and in the calorimeter, are negligible in view of the precision sought, which was from 3 to 10 per mille, and all that the purity of the metal samples warranted.

The metal specimens, about 27 g. in weight, were used in closed silica glass tubes, which protected them from oxidation and supported them while melted. To avoid bursting at the high temperatures the tubes were nearly exhausted before sealing. This necessitated first drawing out a thick-walled capillary. I am greatly indebted to Dr. E. G. Zies of this laboratory for this difficult work on the silica glass. The tubes sometimes collapsed, which did no harm. Before exhaustion they were filled with nitrogen, but the trace of gas left would have been negligible if it had been pure oxygen. If the nitrogen did any good, it was in protecting the metal during the inclosing process.

The furnace cavity was vertical, 2.8 cm. wide by 25 cm. high. Three platinum-faced partitions at each end shut off, in part, the heat loss at the ends, and left an inner working chamber about 16 cm. high. In the center of this hung the silica glass tube containing the metal cylinder. The tubes were 13 mm. in diameter outside, and about 6 cm. high. In the 6 mm. annular space around the tube was the platinum-rhodium thermocouple which served as a thermometer. This couple agreed throughout, within 1 deg., with a carefully-kept standard, which had been calibrated against the original "Element G" of the Day-Sosman high-temperature scale determination, confirmed by gold, silver and palladium meltings. The only remaining uncertainty in the temperature of the metal specimen lies in the difference of metal and thermometer, and since the temperature measurement in the furnace is the only appreciable source of error, this difference mainly determines the precision attained. This difference was directly observed by combining with the regular couple a differential couple of fine wire (0.2 mm.) running to a heavy-walled platinum cylinder in an unsealed silica tube. This platinum cylinder took the place of the nickel or Monel cylinder, which could not well be used in a tube left open for the passage of the wire. The results of two series of observations on two successive days are shown in Table I. There is a

TABLE I. TEMPERATURE DIFFERENCES BETWEEN THERMOMETER AND TEST METAL IN THE FURNACE

Nov. 12, 1920			Nov. 13, 1920		
Time, minutes after reaching temp.	Difference Microvolts	Degrees	Time, minutes	Difference Microvolts	Degrees
Temperature * from 1256° to 1262°			Temperature from 1253° to 1256°		
			7	220	18
			10	206	..
			15	191	..
			18	185	15
			25	167	14
30	154		30	158	..
34	148		35	149	12
41	137		40	139	..
47	129	11	50	125	..
52	121	10	..	....	..
56	118	..	..	....	..
Moved specimen and thermometer 4 mm. toward thermometer side of tube					
63	101	8	60	114	..
Returned specimen and thermometer 2 mm.					
66	108				
			70	106	..
			80	99	8
			95	92	..
			120	81	..
Temperature 1394° to 1399°					
3	101	8			
10	97	..			
18	92	..	About 12 microvolts = 1°		
Moved specimen and thermometer toward thermometer side of furnace tube					
25	52	..			
33	46	..			
Moved specimen and thermometer 4 mm. away from thermometer side of tube					
34	64	5			
41	54	..			
44	51	..			
Replaced them and opened top of furnace					
48	61	..			
54	49	..			
61	34	3			

* The time when 1,256 deg. was reached on Nov. 12 was not noted, since its importance was realized only as a result of the experiment of this day. This time is therefore inferred by comparison with the curve for the next day, and is doubtless affected by a small, unimportant error.

[1] F. Wüst, A. Meuthen and R. Durrer, "Thermal Constants of Technical Metals," *Ver. deutsch. Ing. Forschungsarbeiten*, No. 204, 1918.

change with time which is sometimes greater than the minimum value of the temperature difference. The direction of this change shows that it cannot be due to the lag of the tube or metal. It arises no doubt from a very protracted warming up of the ends of the furnace. After the first ten minutes an uncertainty of ten minutes in time evidently produces less than 2 deg. error.

Three degrees was the greatest change in the differential temperature reading produced by shifting the tube 4 mm. A greater change might conceivably occur in practice from a tilting of the tube in the furnace, but 10 mm. was the maximum possible displacement in this case, and 8 mm. is more than is probable. The greatest error from this source, then, is not likely to be over 6 deg. These errors in temperature are, for timing, 0.14 per cent of the specific heat, and for position, 0.4 per cent. The agreement of the results, to 0.6 per cent or better in all the metal drops but one, with errors

TABLE II. RECORD OF THE OBSERVATIONS

Silica glass containers, blank

Serial number	10	11	12	16	21
Time at upper temp., minutes	25	17	10	30	35
Blank-thermometer, deg.	14	16	8	6	5
Temp. of blank, deg.	1271	1272	1404	1403	1402
Temp. fall, blank, deg.	1248	1249	1380	1380	1379
Thermal leakage correction, deg.	0.02	0.014	0.020	0.026	0.025
Corrected temp. rise, calorimeter	1.019	1.282	1.417	1.392	1.415
Total calories	2868	3609	3977	3919	3983
Calories calc. for Pt.	992	994	1112	1094	1115
Total for glass blank	1876	2615	2865	2825	2868
Wt. of glass blank	5.822	8.076	7.868	7.710	7.835
Calories per g. glass	321.8	324.8	364.1	366.9	366.1
Calories per g. per deg.	0.258	0.260	0.264	0.2653	0.2654

from every source included, confirms in an entirely independent way the estimates just made of the magnitude of the errors. It is clear that this applies to the systematic as well as the accidental error, since the only way for a systematic error to enter would be in case the temperature difference from thermojunction to metal were different during the initial test from its value at all other times. Any large variation of this sort is very improbable in view of the small magnitude of the observed discrepancies throughout the work.

Experimental Results

In order to correct for the heat given out by the silica tube, trial tubes, loaded with the platinum cylinder, were dropped at two temperatures, 1,260 deg. and 1,400 deg. In this way the mean heat loss in the drop was also corrected for, and only the irregularity of this heat loss remained to affect the results, since this loss was not affected by having the metal inside the container. These tube determinations appear in Table II.

The results of all complete determinations, with the magnitude of all the important quantities concerned, are given in Table III.

The latent heats are found as the difference of total heat of fused metal and total heat of solid metal at the same temperature. It is well known that impurities cause an incipient melting which may falsify the observed specific heat of substances over a temperature interval of many degrees below the melting point. For this reason the observations on solid metal were taken at temperatures nearly 100 deg. below the melting point or interval, and these values were used to calculate the total heat up to the assigned temperatures of melting. The values of specific heat assumed over the calculated interval were taken, somewhat arbitrarily, as the mean specific heat up to the temperature of observation and were, for nickel, 0.134; for Monel metal, 0.128. Since the specific heats of these metals do not vary rapidly in this region, the assumption cannot involve appreciable error. The difference between the specific heat of solid and liquid metal, also, is small enough so that a variation of 20 deg. or so in the assigned melting temperature makes little difference in the heat of fusion of nickel, and the assigning to Monel of a latent heat at a single temperature, instead of over an interval, leads to a value for this latent heat which has nearly the precision of the observations and is positively defined. It seems impossible to do any better until we have more reliable values for the various specific heats concerned.

Results From Pouring Molten Metal

Before the work in silica inclosures was undertaken, the total heat of melted nickel was found by pouring the metal directly from crucibles into the calorimeter, using the first appearance of solidification to indicate the temperature, which was therefore the melting point. About 60 g. was taken, and the rate of cooling of the charge was necessarily very rapid, perhaps over 100 deg. a minute. Some practice was required in catching the right moment for pouring; the last two samples left some solid metal behind in the crucible. These results are also given in Table III. The method, at the stage to which we carried it, was still somewhat subjective, and the excellent agreement with the electric furnace determinations does not so much add to these as show something of the excellence of the pouring method. These pouring results do, however, furnish a very convincing and largely independent confirmation of the others in so far as they indicate that Wüst's result for the total heat of melted nickel is too low by an amount corresponding to a temperature difference of about 120 deg. For two things show that the poured nickel in the two cases can hardly have been 120 deg. high, and probably

TABLE III. METAL TEST SPECIMENS

	Monel Solid			Monel Melted		Nickel Solid		Nickel Melted		Nickel Poured	
Serial number	8	9	20	14	17	13	15	18	19	6	7
Time at upper temp.	45	15	30	25	25	23	30	27	17	....	....
Test-thermometer diff., deg.	11	17	13	7	7	9	8	5	6	....	....
Temp. of test, deg.	1267	1273	1270	1404	1403	1360	1359	1469	1469	1448	1448
Temp. fall test, deg.	1244	1250	1246	1379	1378	1336	1335	1444	1443	....	....
Thermal leakage corr'n, deg.	0.030	0.024	0.040	0.038	0.047	0.036	0.038	*	0.060	0.060	0.041
Temp. rise, calorimeter, deg.	2.266	2.358	2.583	3.096	3.777	2.681	3.045	*	3.806	5.751	5.852
Total cals.	6377	6641	7271	8725	10632	7547	8571	*	10713	16189	16474
Calc. for Pt.	145	145	148	178	165	172	159	177	177	....	....
Calc. for glass	2185	1901	2828	3000	3515	2075	3464	3258	3305	....	....
Cals. metal	4048	4595	4293	5547	6952	5300	4948	*	7231		
Wt. metal	25.330	29.075	27.112	22.892	28.527	29.591	27.508	26.972	27.114	60.27	62.15
Wt. glass	6.783	5.872	8.755	8.214	9.630	5.905	9.866	8.445	8.572	....	....
Cals. metal per g.	159.8	158.0	158.3	242.3	243.7	179.1	179.9	*	266.7	268.6	264.8
Cals. per g. per deg.	128.4	126.4	127.2	.....	.....	134.2	134.7	....	....	....	....
Total heat, solid calc. to upper temp.				175				194.0		191.3	
Latent heat, mean				68				73		77	

*An accident stopped the stirring, but late enough in the experiment so that the uncertainty was only a part of the leakage correction, or about 1 per cent. Since the est estimate proved to coincide almost exactly with 19, a repetition would have added little to the probable accuracy of the result as now given.

not 20 deg.: the fact that solid metal was left behind, and the fact that the measured gas furnace temperature was only 50 deg. above the melting point when the crucible was removed, to be cooled some seconds in the air before pouring. In a third pouring there was doubt about the weight of the metal, hence this is not reported. Thanks are due to A. F. Buddington, then of this laboratory, who attended to the furnace and the pouring while the temperatures were being read electrically in the room above, and to C. M. Saeger, Jr., of the Bureau of Standards, who furnished a number of small zircite crucibles which stood excellently the rather severe treatment involved in the manipulation. This pouring method is evidently not so well adapted to an alloy like Monel, which has a melting interval.

Analyses of specimen metals after the determinations, kindly furnished by the International Nickel Co., are given in Table IV. They seem to show quite clearly that appreciable oxidation, either of metal or impurities, did not occur in any case, and hence that no appreciable heat from this source falsified the determinations. There was, moreover, no opportunity for oxidation during the drop of the inclosed specimens, since the silica tube was usually heard to crack, under water, about a minute after it was dropped. The metal cylinders, weighed after the experiment, showed no change as great as 1 mg. for the unmelted specimens; after melting there were negligible changes of 10 mg. or less, and even these were probably due to reaction with the silica glass, of which there were clear indications.

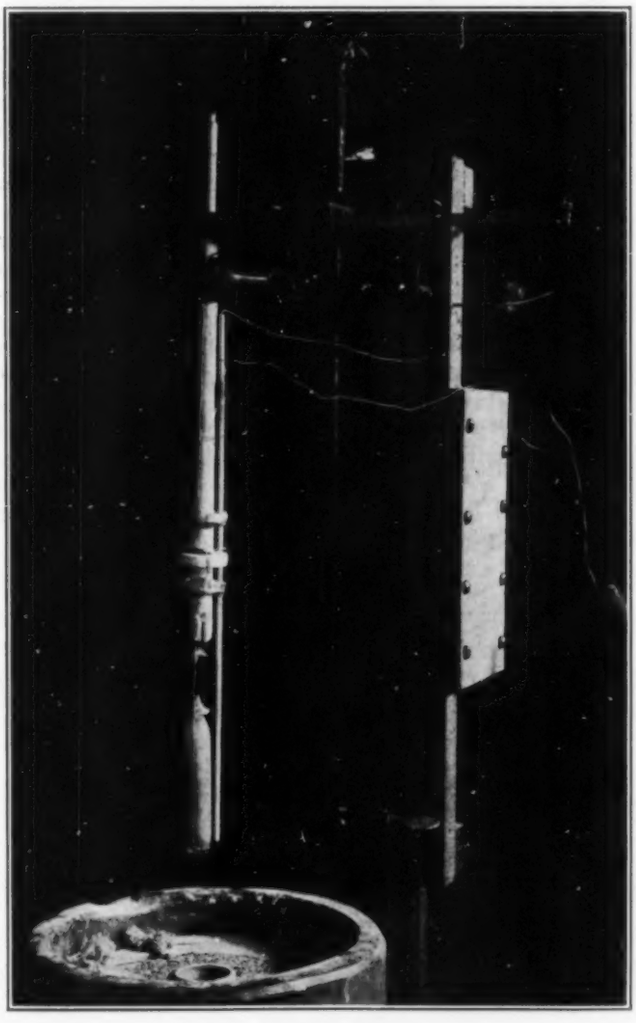


FIG. 1

Dropping mechanism, upper partitions, thermel and test objects inclosed in silica glass and suspended by platinum wires. The junction is a little too low in this view. The diameter of the larger Marquardt tube is 1 cm.

TABLE IV. COMPOSITION OF THE METAL SPECIMENS

	Nickel		Monel	
	Usual	Test Sample after Pouring	Usual	Test Sample after Melting
Copper	0.16	0.17	28.0	26.39
Nickel	99.1	99.02	68.0	69.03
Iron	0.35	0.40	2.0	2.53
Sulphur	0.02	0.029	0.03	0.047
Silicon	0.25	0.17	0.10	0.10
Carbon	0.10	0.10	0.18	0.15
Manganese	.....	0.10	1.50	1.74

WÜST'S METHODS

For comparison it seems desirable to review, briefly, Wüst's methods. His furnace was in a highly exhausted tube, which extended down into an ice calorimeter. The solid metals were ordinarily used bare, but were inclosed in silica glass when they were to be melted. Comparisons with the three solid metals silver, gold, copper up to 900 or 1,000 deg. showed no difference, due to inclosure, in the specific heat so observed. The furnace thermel—i.e., thermoelectric thermometer—which was, as in our work, alongside the specimen, was found to be at the same temperature. In these special tests, as in most of the regular observations, the agreement was usually to 1 per cent. The tests and agreements reported are thus entirely favorable.

The furnace, however, was entirely open at the bottom, which presumably caused much greater temperature differences through radiation than there were in our carefully partitioned furnace. The high vacuum should have greatly diminished conduction and convection of heat, leaving heat transfer dependent on radiation. This evidently has a tendency to make the temperatures of inclosed bodies depend more on that of distant objects and on possibly variable radiating power. In Wüst's calorimeter the specimen fell into a metal box with a sheet nickel lid, which, still surrounded by vacuum, rested in a glass tube. The heat transfer was thus probably almost entirely by solid contact and radiation, and would therefore tend to vary with slight changes in the lie of the specimens or in the character of their surfaces, causing variations in the amount of heat escaping upward. In our case the specimen was dropped at once under water, and most of the heat transfer was over in the first minute. Wüst's agreement with the work of others is not very good. For the six metals aluminum, chromium, cobalt, copper, nickel and silver he differs in every case by from 4 per cent to 8 per cent at 100 deg. from Tilden or Schübel, who usually agree with each other to 1 per cent.[2] At 500 deg. Wüst's discrepancy is less, but compared with specially accurate determinations in the Geophysical Laboratory, his value for silica glass, though high at 100 deg., is 5 per cent too low at 900 deg. He agrees to 2 per cent or better with our value for platinum from 200 to 1,400 deg.

EXPERIMENTAL DETAILS

Several features of the present apparatus and procedure were the same as used in 1908 and later,[3] and are

[2] For a convenient tabulation of their data I am indebted to a valuable résumé of other work given by Wüst himself. In this, however, he compares indiscriminately his own and other results for silica glass ("quartz" glass) with results for crystalline quartz.

[3] Walter P. White, "Specific Heats of Silicates and Platinum," *Am. J. Sci.*, vol. 28, p. 334 (1909); "Some Calorimetric Apparatus," *Phys. Rev.*, vol. 31, p. 670 (1910); "Specific Heat Determination at Higher Temperatures," *Am. J. Sci.*, vol. 47, p. 44 (1919).

already published. Thus: (1) the dropping of the specimen was performed by a mechanical arrangement. (2) The lower partitions were first dropped into a box, the "swinging shield," which was then swung aside by hand to open the path to the calorimeter, and immediately returned to close it against radiation from the furnace. Thus neither furnace nor calorimeter needed to be moved. The motion of the shield operated the dropping mechanism. (3) The use of partitions has been mentioned, and so has (4) the method of eliminating the effect of the heat loss during the drop by subtracting the heat given to the calorimeter by the empty container. (5) The calorimeter temperature was read by a thermel (thermoelectric thermometer) to 0.0003 or 0.00025 deg.;

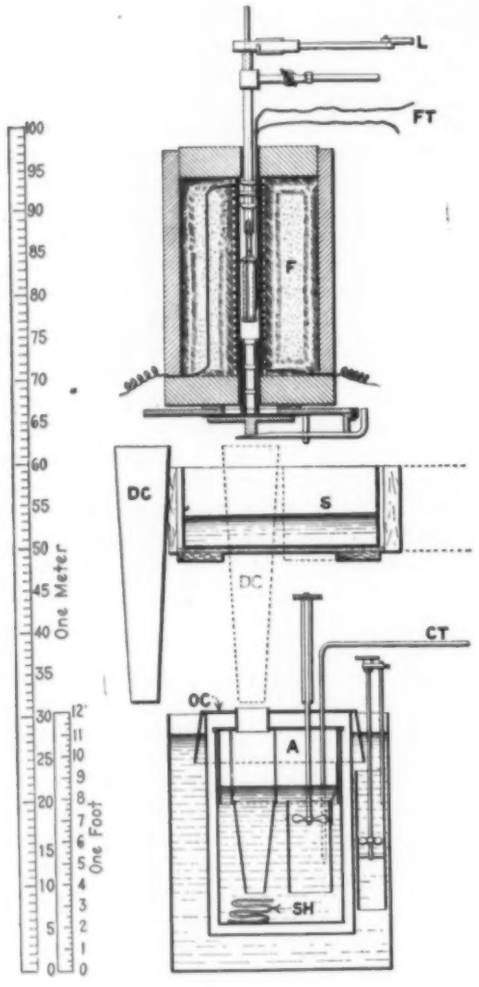


FIG. 2

Furnace *F*, with partitions, swinging shield *S* and calorimeter with jacket. *FT*, furnace thermel, one platinum-rhodium couple; *CT*, calorimeter thermel, 10 copper-constantan couples; *DC*, cone for directing the falling object also shown, dotted, in position for the drop; *L*, lever for rotating the inner rod in the dropping mechanism; *A*, air space above the water inside the calorimeter; *OC*, jacket cover of sheet copper 0.77 mm. thick; *SH*, cushion. Some supports are not shown. To scale, except that the furnace was 23 mm. higher than here represented.

(6) the thermal head (temperature difference of jacket and calorimeter) was measured directly. This facilitated the use of a calorimetric method which is especially advantageous where the calorimeter is opened to the air at the beginning of the experimental period.[4]

Important differences from the earlier work were: (1) The furnace chamber was narrower (2.8 cm.), which made for uniformity, though (2) this advantage was neutralized by the fact that the furnace coil was not concentrated at the ends. (3) The falling container was guided by a cone of coarse wire gauze, so that misdirected drops, a great detriment in the earlier work, were entirely avoided, while a smaller opening into the calorimeter could also be used. This cone was attached to the swinging shield and brought into place by it, being out of the way except when the shield was near the position for the drop. Wire gauze was used instead of sheet metal to prevent the reflection of radiant energy from the furnace down the cone into the calorimeter; its use also tended to diminish the amount of cold material touching the hot container in its fall. (4) The calorimeter top was arranged so as largely to prevent loss of heat as the container went into the water. In our earlier work there was merely a device for returning to the calorimeter the bulk of the water thrown up in the splash; the amount of steam produced was slight, and was expected to be fairly constant for a given temperature of the container; such constancy was all that was necessary in the method used. The results obtained with the older arrangement, however, indicated very strongly[5] that inconstancy in the heat loss at the water surface was the main source of error, sometimes reaching 1 per mille. The manipulation of the splash-restraining device also delayed the closing of the calorimeter. In the present set-up the calorimeter cover, Fig. 2, comes 7 cm. above the water, so that under it is a space of about 1,100 c.c. from which little steam or splash water escapes through the narrow opening which admits the test specimen. This cover is of heavy copper 0.77 mm. thick, so that in temperature it is always practically a part of the calorimeter surface.

The dropping mechanism (Figs. 1 and 2) was simpler and much more compact than that described in 1918, and contained no platinum.[6] It consisted of a tube of Marquardt mixture 10 mm. in diameter slotted after the plan of a bayonet joint, so as to hold the horizontal platinum wire which was the top of the container hanger, but so as to let this drop when it was rotated into the vertical part of the slot. The rotation was accomplished by a Marquardt rod, slotted at the bottom to take the wire.[7] Of a number of test drops made outside the furnace, all landed within 2 cm. of the perpendicular after falling 50 cm.

Details of Construction

The furnace tube, platinum winding and alundum cement used to hold this, all formed a compact tube only 6 mm. in wall thickness. Outside this was calcined magnesia. At the ends were Buffalo fireclay disks

[4] Walter P. White, "Some Calorimetric Methods," *Phys. Rev.*, vol. 31, p. 547 (1910).

[5] Walter P. White, "Specific Heat Determination at Higher Temperatures," *Am. J. Sci.*, vol. 47, p. 55 (1919).

[6] Marquardt mixture is a remarkably valuable material for structures such as these dropping mechanisms. It keeps its form and enough of its strength indefinitely at high temperatures, probably as high as 1,500 deg.; and when in the form of tubes 2 mm. thick and 10 mm. in diameter can be repeatedly withdrawn from the furnace at 900 deg. without injury. Platinum, however, becomes soft and tends to stretch or loosen at high temperatures, enough so that structures fastened with it rapidly become disarranged and need frequent overhauling.

[7] This mechanism proved the most satisfactory of three that were tried. It was suggested by H. S. Roberts of this laboratory. It could not well have been constructed without a diamond saw. The two others were easier to make. Each had about half of the outer tube ground away for a centimeter or so from the lower end, leaving a projecting lip. In one an inner tube or rod had a notch for the wire; as this rod was rotated the projecting lip pushed the wire free. In the other mechanism the wire rested in notches in the exposed edges of the lip and was pushed out by forcing a Marquardt wedge down the tube. The wedge frequently stuck. A stop is also necessary in front of the notches to keep the wire from leaving one, turning on the other as a pivot, in which case it may drop prematurely or not at all.

3 cm. thick. Once when the upper one of these was removed neither furnace temperature (1,394 deg.) nor temperature distribution showed any change exceeding 2 deg. for fifteen minutes. Apparently the disk was a heat distributor as much as a heat insulator. Advantageous modifications of the end construction could doubtless be made.

The furnace stood on an iron plate, which had a hole under the furnace opening. A removable plate closed this hole till the time of the drop. All joints between and above the plates were carefully sealed with asbestos paper or rope, since a very slight upward current of air through the furnace may seriously affect the temperature distribution.

The silica containers were supported by a platinum wire loop passing under the bottom. Small, nearly horizontal, platinum disks at top and bottom still further cut off radiation to the colder furnace ends. The two wires, each 0.6 mm. in diameter, supported over 35 g. for nearly an hour at 1,460 deg. without perceptible stretching.

In order to minimize strain on the somewhat delicate dropping mechanism, the following precautionary features were introduced:

(1) The supporting surfaces along which the wire slid when rotated were not horizontal, but inclined so as to favor turning without causing it.

(2) The rotating force was applied at the end of a rather long (12 cm.) lever, by means of a string passing over a pulley to a weight which fell as a loose piston through a cylinder of water; thus giving a very even motion with little side pressure on the rotating rod.

(3) In preventing rotation during the preliminary manipulations no clamp was applied to lever or tube, but the far end of a rod was fastened whose other end was loosely pivoted to the lever. A suitable stop would probably have been still better.

SUMMARY

By the common method of dropping from a furnace into a calorimeter, the latent heats of nickel and of Monel metal have been determined, and their specific heats for the intervals to 1,360 and 1,260 deg., respectively. The metals were protected against appreciable oxidation by sealing into silica glass containers. The precision of the temperature measurement was studied, and the results indicate a final accuracy of better than 1 per cent. This indication tends to be confirmed by the agreement of all the determinations but one, which was 1.3 per cent divergent. Several determinations were made by pouring directly into the calorimeter nickel just ready to solidify, giving agreement to about 2 per cent with the furnace results. The latent heat of nickel, 73 calories per gram, is 17 calories greater than the recent determination of Wüst. The latent heat of Monel, 68 calories, is in excellent agreement with that of nickel.

The International Nickel Co. furnished material and analyses for this study, and bore part of the direct expense.

Geophysical Laboratory.
Carnegie Institution of Washington.

Lithium Minerals in 1920

According to the Geological Survey, 11,696 short tons of lithium minerals valued at $173,002 was produced in 1920. Lepidolite from the Stewart mine at Pala, Cal., was used in glass manufacture, while spodumene from the Etta and Swanzey mines, near Keystone, S. D., was used in the manufacture of various chemicals.

Physical Properties of Molybdenum Steel*

BY ARTHUR H. HUNTER
President, Atlas Crucible Steel Co.

MOLYBDENUM steels, as a class, when compared with other alloy steels which are in the same category from a commercial standpoint, treated to the same tensile strength, show:

1. A slightly higher elastic limit, hence a somewhat higher elastic ratio.
2. A higher elongation, hence greater ductility.
3. A much higher reduction of area, hence appreciably greater toughness.

This latter property is probably the most pronounced individual physical result of the addition of molybdenum to steel. From a great deal of data covering these three points, the writer has chosen the following tests, made under the supervision of Dr. J. S. Unger of the Carnegie Steel Co., as exemplifying them in the simplest manner.

Five steels, embracing only the accepted commercial tonnage types, analyzing as shown in Table I, were all heat-treated to give the same tensile strength—i.e., approximately 125,000 lb. per sq.in. The results were as shown in Table II.

TABLE I. ANALYSES

Type of Steel	C	Mn	Ni	Cr	Mo
1. Carbon	0.62	0.45	....	....	....
2. Chrome	0.49	0.53	....	0.60	....
3. Nickel	0.40	0.65	3.61	....	....
4. Chrome-nickel	0.43	0.57	1.60	0.46	....
5. Chrome-molybdenum	0.32	0.72	....	0.80	0.27

Compared with the carbon steel, the chrome-molybdenum showed 33 per cent increase in elastic ratio, 16⅔ per cent increase in elongation and 56 per cent increase in reduction of area. Compared with the nearest alloy steel, the chrome-molybdenum showed 1.7 per cent increase in elastic ratio, a little over 6 per cent increase in elongation and 12.8 per cent increase in reduction of area. The tensile strength of all these steels having purposely been made the same, the only possible variables were these three.

TABLE II. PHYSICAL PROPERTIES

Type	Tensile Strength, Lb. per Sq.In.	Elastic Limit, Lb. per Sq.In.	Elastic Ratio	Per Cent Elongation in 2 In.	Reduction of Area, per Cent	Izod Foot-Lb.
1. Carbon	126,175	84,380	66.9	18.0	43.6	5.0
2. Chrome	125,300	107,225	85.6	18.0	56.5	66.5
3. Nickel	127,975	112,525	87.9	18.8	51.4	54.5
4. Chrome-nickel	127,975	111,025	86.8	19.8	60.3	54.0
5. Chrome-molybdenum	125,650	112,250	89.3	21.0	68.0	90.0

In direct relation to the foregoing it should be noted that tests by the Izod machine on these steels showed chrome-molybdenum to possess a resistance to impact of eighteen times that of the carbon steel and 34 per cent greater than the nearest alloy steel. As the impact test merely measures the work of rupture under a suddenly applied load, these results, which have been amply corroborated, clearly show the cumulative effect of the higher elastic ratio, elongation and reduction of area for a given tensile strength possessed by the

*Portions of a paper read before the American Iron and Steel Institute, May 27, 1921.

molybdenum steels. Bending tests further bear this out.

In order to give an idea of how the chrome-molybdenum series of alloy steels compares with chrome-vanadium steels, a comparison of two types of each follows. The data on both of the chrome-vanadium steels are taken from a recent booklet published by the Vanadium Corporation of America presenting charts plotted by the metallurgical department of the United Alloy Steel Corporation. The data on both of the chrome-molybdenum steels were furnished the writer by the metallurgical department of the same company. Both series of tests were made on steels manufactured in the open hearth.

TYPE 1—0.40 TO 0.50 CARBON

Type	C	Mn	Cr	V	Mo
Chrome-vanadium	0.47	0.85	1.19	0.15	....
Chrome-molybenum	0.41	0.68	0.95	....	0.24

Sections ¾ in. round, quenched in oil from 1,560 deg. F. (V) and 1,500 deg. F. (Mo). Drawn to show tensile strengths indicated.

Type	250,000 lb. T. S. E. L.	El. %	R/A.	225,000 lb. T. S. E. L.	El. %	R/A.	200,000 lb. T S. E. L.	El. %	R/A
Cr-V	215,400	11.0	38.5	201,000	12.3	42.3	184,000	14.0	47.0
Cr-Mo	222,000	9.0	43.5	201,000	10.3	47.9	179,000	13.3	52.2

TYPE 2—0.23 TO 0.30 CARBON

Type	C	Mn	Cr	V	Mo
Chrome-vanadium	0.27	0.71	0.98	0.15	....
Chrome-molybdenum	0.28	0.64	0.70	....	0.20

Sections, ¾ in. round, quenched in water from 1,625 deg. F. (V) and 1,525 deg. F. (Mo). Drawn to show tensile strengths indicated.

Type	175,000 lb. T. S. E. L.	El. %	R/A.	150,000 lb. T. S. E. L.	El. %	R/A.	125,000 lb. T. S. E. L.	El. %	R/A.
Cr-V	157,300	15.0	60.5	137,500	17.7	62.8	112,400	21.2	66.9
Cr-Mo	163,400	15.5	59.3	141,200	18.7	63.4	117,800	22.8	69.0

It should be noted that the molybdenum content of both of these types of the chrome-molybdenum steel is extremely low. For a comparison on a purely commercial basis steels containing double the above content of molybdenum and showing higher physical properties might well have been used. Considering the lower manganese, chromium and molybdenum contents of the last-mentioned molybdenum steel, a comparison between its properties and those given in the table of Dr. Unger is interesting.

It has been stated above that the physical properties of molybdenum steel were progressively better as the molybdenum content is increased up to 1 per cent, and the table of properties below is presented to illustrate this point:

Sections from which the test-pieces were cut were 1¼ in. round or 1¼ in. square, quenched in water from 1,550 deg. F. to 1,600 deg. F., drawn to show a tensile strength of 175,000 lb. per sq. in.

ANALYSIS RANGE

C	Mn	Cr
0.28 to 0.36	0.44 to 0.64	0.70 to 1.04

PROGRESSIVE EFFECT

	Mo 0.20	Mo 0.40	Mo 0.76
Elastic limit	167,000	164,000	162,000
Elongation, per cent in 2 in.	13.5	16.6	19.5
Reduction of area, per cent	52.0	58.4	61.0

For a constant tensile strength and very nearly constant elastic limit the ductility of the steel is greatly increased by the addition of molybdenum from 0.20 up to 0.76. Conversely, of course, by employing suitable drawback temperatures, for a given ductility the elastic limit and tensile strength will show an increase in like manner.

The comparative effect of increased section on chrome-molybdenum and chrome-vanadium steels is shown by the following average results on different sizes of both, taken from test-bars cut from commercial stock:

ANALYSIS RANGE

	C	Mn	Cr	V	Mo
Chrome-vanadium	0.23 to 0.30	0.60 to 0.80	0.70 to 1.00	0.15 to 0.20	.....
Chrome-molybdenum	0.23 to 0.30	0.60 to 0.80	0.70 to 1.00	.....	0.25 to 0.35

EFFECT OF SECTION

Size	Elastic Limit Cr-V	Elastic Limit Cr-Mo	Tensile Strength Cr-V	Tensile Strength Cr-Mo	Elastic Ratio Cr-V	Elastic Ratio Cr-Mo	Elongation Per Cent Cr-V	Elongation Per Cent Cr-Mo	Reduction of Area Cr-V	Reduction of Area Cr-Mo
1 1/2-in.	134,200	134,800	153,200	156,200	87.6	86.2	16.8	16.8	57.1	59.0
1¾-in.	123,100	132,300	145,500	153,700	84.7	86.3	15.8	16.3	55.8	56.8
1 7/8-in.	116,900	133,500	150,300	153,200	77.7	87.1	15.1	16.8	53.2	56.5
1 15/16-in.	103,200	124,600	137,500	152,200	75.3	81.9	14.0	16.3	46.3	55.4

The more complex quarternary alloy steels containing molybdenum show extremely high characteristics, as will be seen by reference to the following tables. Both of these steels can be drawn back to better than 1,000 deg. F. before the tensile strength falls below 200,000, and to 900 deg. F. before the elastic limit falls below this figure. The steel containing nickel exhibits remarkable physical properties at low drawing temperatures such as are employed in the production of oil-hardened gears, whereas the steel containing vanadium possesses greater possibilities at the higher drawing temperatures:

	C	Mn	Cr	Ni	V	Mo
Chrome-nickel-molybdenum (1)	0.44	0.42	0.99	2.04	....	0.36
Chrome - vanadium - molybdenum (2)	0.38	0.60	1.00	....	0.18	0.80

Sections, ¾-in. round (1), quenched in oil from 1,450 deg. F., and 1¼-in. round (2), quenched in oil from 1,600 deg. F., both drawn as indicated.

RESULTS OF TESTS ON (1)
CHROME-NICKEL-MOLYBDENUM STEEL

Drawing Temp., Deg. F.	Tensile Strength	Elastic Limit	Elongation, Per Cent in 2 In.	Reduction of Area, Per Cent
400	336,600*	302,000*	10.0*	22.4*
600	275,000	241,000	11.3	43.0
800	240,000	220,000	12.0	46.0
1,000	204,000	185,000	15.0	51.0
1,200	152,000	134,000	20.5	61.0

* Section treated 0.505 in. round.

RESULTS OF TESTS ON (2)
CHROME-VANADIUM-MOLYBDENUM STEEL

Drawing Temp., Deg. F.	Tensile Strength	Elastic Limit	Elongation, Per Cent in 2 In.	Reduction of Area, Per Cent
600	243,000	217,000	9.0	38.2
800	225,000	207,000	10.8	45.4
1,000	210,000	197,000	14.0	52.5
1,200	186,000	174,000	18.2	59.7

A low-carbon steel to which about ¼ per cent molybdenum is added possesses extreme ductility, which makes it particularly adapted in sheet form to the manufacture of pressed steel parts and at the same time when heat-treated is capable of showing fairly high physical properties. Tests made on such a sheet steel test-piece 1½ in. wide by 9 in. long follow. The quenched specimen was cooled in water from 1,600 deg. F. and then drawn to 900 deg. F.

ANALYSIS

C	Mn	Mo
0.164	0.45	0.226

Thickness of Sheet, In.	Condition	Elastic Limit, Lb. per Sq. In.	Per Cent Elongation in 2 In.
1/8	As rolled	45,640	44.5
1/8	Quenched	120,470	7.5

Molybdenum steels also have the property of deep hardening, especially noticeable in the chrome-molybdenum series. Their properties are developed at higher drawing temperatures than employed with other steels, a fact directly related to their greater toughness and resistance to fatigue.

Dunkirk, N. Y.

Boiler Feed Water Purification

An Outline of the Respective Merits of the Various Methods Used for Boiler Feed Water Treatment, With Special Reference to the Advantages of the Zeolite Water-Softening Process

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THE present-day means used for purifying boiler feed water can be grouped into three distinct classes—namely, boiler compounds, precipitation apparatus and zeolite apparatus. Each of these means has its advocates, and the following outlines the advantages and disadvantages of each and points out which is relatively important and which unimportant, especially from the practical operating viewpoint.

Boiler Compounds

The use of boiler compounds means the treatment of the water inside the boiler as differentiated from the use of water-softening apparatus which completes the treatment before the water enters the boiler. A great variety of substances have been employed for this internal treatment. Among them may be mentioned soda ash, caustic soda, barium compounds, graphite, tannin, kerosene, slippery elm, glucose, etc. Proprietary secret compounds are usually made up of a mixture of one or more of these substances.

In general, the action of boiler compounds may be divided into two classes:

1. The reduction of hardness by chemical reactions which is exemplified by the use of soda ash and caustic soda.

2. The mechanical action on the scale with the intention of coating the grains to interfere with their close cementation. This is typified by the use of tannin, graphite, slippery elm.

The claims that the action of the second class of compounds was mechanical rather than chemical had a certain appeal to the operating engineer, to whom chemistry has been and still is somewhat of a mystery. The general failure of such compounds to fulfill the fantastic claims made for them has imparted an unscientific atmosphere to the field of internal boiler treatment.

The nature of the chemical reactions with the feed water, however, when boiler compounds of the first class are used is in the same general class with those involved in a precipitation water-softening plant. The important difference is that the precipitates formed by the reactions with the boiler compounds enter the boilers, whereas in the case of the precipitation water-softening plants the precipitates are removed from the water by settling and filtration, only the clear softened water entering the boilers.

The boiler compound advocate makes three claims: First, that the resultant precipitates form a sludge inside the boilers less compact than the scale formed by the hard water and that therefore the first cost or investment in settling tanks and filters may be saved by using the boiler itself as a settling basin. Second, more accurate proportioning of the chemicals is accomplished than in precipitation plants. Third, boiler compounds save the loss of water wasted in washing filters and sludging off settling tanks of precipitation plants.

In answer to these claims the following considerations must be taken into account:

Sludge in a boiler will accumulate and will bake together into a hard layer and the reagents added in general increase the amounts of deposits and the burden of solid content which the boiler has to bear. To maintain the high boiler efficiency to which modern power plant practice has attained, it is essential to maintain the heating surface absolutely clean both inside and outside. It is just as necessary to prevent sludge accumulating on the wet side of the heating surface as it is to keep soot off the dry side. If efficiency is not a consideration, if labor for cleaning is negligibly cheap and if fuel be plentiful and extremely low in price, then the use of boiler compounds may be permitted, but these conditions, although they may have been found formerly, no longer exist today.

Regarding the second claim, of greater accuracy of proportioning, this is difficult to substantiate. The same problem exists in both cases of adding definite amounts of certain chemicals in accordance with the composition of the incoming water and also to proportion the volume of chemical solution to the volume of water to be treated. A general inspection of the usual boiler compound feeding devices and of the precipitation plant chemical feed controls will disclose a contrast in favor of the latter from the point of view of refinement, mechanical ingenuity and reliability of action. Furthermore, it is possible to check up the results of treating a water in precipitation water softeners by analyzing the effluent before it enters the boiler and so adjust the treatment until the desired results are obtained. By using boiler compounds it is possible to check up on the efficacy of the dosage only by inspecting the boilers after they are taken "off the line."

The third claim is correct, but offsetting it is the loss of heat in the water blown off from the boiler. If the boiler is to receive the precipitates, and the sludge formed by the boiler compound is not to accumulate, it must be blown off. The heat lost in the blowoff water above 250 deg. F. required to sludge off the boiler is one of the most serious penalties incurred by the use of the boiler itself as the precipitation tank.

Precipitation Water Softeners

Precipitation water softeners embody the main principle of adding prescribed amounts of definite soluble chemicals, usually lime and soda ash, to react with the hardening compounds of the raw water.

There are two main divisions of precipitation plants—namely, intermittent and continuous. The former consists of two or more settling tanks, one filling and receiving its charge of chemicals while the other is

being used to deliver treated water to service. In this way each tank goes through a cycle of operations—filling, charging, agitating, quiescent settling and finally emptying. The continuous plants usually have one settling basin, and the water flows continuously from inlet to outlet, receiving the charge at the inlet, settling as it flows and after filtering leaves at the outlet completely treated.

Intermittent plants are preferred for the treatment of waters which vary in composition between wide limits because the average composition of a tankful of water can be determined irrespective of the variations that may have taken place as the tank was being filled.

Some continuous plants have heaters ahead of the settling tanks and permit the reactions and settling to take place at boiling temperature. Although this gives a resulting effluent of lower hardness and a smaller settling tank is permissible because of more rapid reactions, the loss of heat by radiation from the settling tanks and filters and also by losing hot water in sludging off and washing of filters must be considered.

Zeolite Water Softeners

Zeolite plants accomplish the removal of the hardness by percolation of the water through a bed of zeolite material suitably supported and distributed in a closed or open container with piping and valves attached to the container properly to distribute and control the flow of water. The hardness is removed from the water by the well-known zeolite exchange principle, the zeolite exchanging its sodium base for the calcium and magnesium bases in the water. A meter is provided to indicate when the softener has passed the quantity of water it was designed to soften. The zeolite bed is then automatically regenerated or revivified by passing a solution of salt (common brine) through the softener. The brine, by a reversed exchange reaction, gives its sodium base to the zeolite, and as it leaves the softener it carries with it in a clear solution the calcium and magnesium extracted from the zeolite. Where 24-hr. operation is required, one softener treats the water while the other is regenerated and they are consequently switched at proper intervals to provide continuity of operation. A tank is provided to make the brine and its flow to and from the softeners is automatically accomplished by properly designed equipment which forms an integral part of the modern zeolite softener. The zeolite is then rinsed free of brine and the softener is again thrown into service by opening the necessary valves.

Space Required for Water Softeners

For cold-precipitation plants it is customary to allow a minimum of four hours for the reactions to take place and the precipitates to settle. This means a tank or basin holding four hours' supply of water. For a capacity of 10,000 gal. per hour a 40,000-gal. tank would be required, say 15 ft. in diameter by 32 ft. high. This is generally too large to be accommodated in existing buildings. It must be located outside and thus involves extra land, foundations and housing, all of which should be added to the cost of the apparatus when making comparisons.

Zeolite plants accomplish complete removal of the hardness in several minutes; for example, a water of 10 grains of hardness per gallon is softened to zero hardness in approximately ten minutes. For a capacity of 10,000 gal. per hour and for an average water of 10 grains per gallon of hardness a zeolite softener 10 ft. in diameter by 10 ft. high would be required. This can usually be housed in an existing room, thus saving land, special foundations and extra housing.

Precipitation settling tanks or basins are open, and it is therefore generally necessary to install additional pumping equipment.

Zeolite plants can be and generally are built to withstand existing water pressures and the water passes through the softeners to service without the need for additional pumps. This not only saves initial investment but saves an appreciable operating charge.

Operation of Precipitation Water-Softener Plants

In the operation of precipitation plants, it is necessary to make a chemical analysis of the raw water and a determination of the purity of the chemicals in order to calculate the correct charge of lime and soda ash or other reagents to react with the varying composition of the raw water. Many water supplies are drawn from surface sources such as rivers or ponds. The volume of water in these supplies varies with the seasons and with the rainfall. Sudden storms have been known to change the mineral content of a stream completely in a few minutes. If too little chemical is added to the water the hardness is incompletely reduced and if too much chemical is added an objectionable amount of the excess of chemicals is left in the treated water. The addition of too great an excess of lime may even form a harder water than the original supply, since lime, besides being caustic, is also a form of hardness. The writer has analyzed samples before and after several precipitation plants where this condition was found to exist. The operator must therefore be alert and skilled to control the treatment properly.

Besides the need for skilled supervision to apportion the chemical dosage to suit the composition of the raw water, there are various mechanical problems to solve. Sludge disposal from the settling tanks frequently clogs sewers and some city ordinances prohibit dumping sludge into sewers on this account. This frequently entails sludge collection in pits and removal by digging out periodically and carting away to disposal dumps. The mechanical problem also exists of feeding the chemicals at a rate in proportion to the rate of the raw water flow. This involves a form of meter for the water and a meter for the chemicals. Since the chemicals are usually fed in the form of a suspension of particles or a milk, the meter itself may become coated with the particles, with a resultant change in the rate of chemical dosage. The complexity of this chemical feed problem from the mechanical point of view is evidenced by the many hundreds of devices that have been developed and patented to date.

Operation of Zeolite Water-Softener Plants

The operation of zeolite water softeners marks a radical departure from the precipitation process. The water is distributed uniformly through the bed contained in the zeolite apparatus and in its passage through the bed of zeolite the hardness is completely removed, the calcium and magnesium entering the grains of the zeolite by chemical exchange for the sodium which the grains give up to the water. No sludge is formed and no problem of sludge disposal exists. No chemicals are added and the mechanical problem of controlling the feed of chemicals is avoided. The zeolite, an insoluble reagent, reacts completely with the relatively

small quantity of the salts of calcium and magnesium in the water.

This zeolite exchange principle or reaction is of universal occurrence in the fertilization of soils where the soil absorbs the potassium salts from the fertilizer by a similar chemical exchange.

The fact that the zeolite is insoluble makes possible this complete removal of the hardness from the water without the possibility of there being an excess of reagent in the softened water. The volume of the zeolite used is greatly in excess of the theoretical quantity required for the reaction and thus by mass action drives the chemical exchange—i.e., the softening action—to the end point of zero hardness water.

Slight amounts of hardness in the effluent of some zeolite softeners have been noticed in some cases;[1] but this can mean only that the particular zeolite softeners examined were improperly designed and that the volume of a proper grade of zeolite used was not in sufficient excess so that the softener was seriously overloaded.

If a zeolite softener is greatly overloaded it acts exactly as most mechanisms and structures used in engineering work under excess load. If precipitation water-softening plants are overloaded, the reactions are not completed in the settling tank and the resulting precipitates collect in the outgoing pipe lines, heaters, boilers, etc. A zeolite softener has a definite duty to perform, and if that duty is seriously exceeded the worst possible effect that can result is the production of a water with a slight residual hardness. If the size of the zeolite softener is correctly selected to take care of the required volume of water containing a known hardness, the effluent of the softener is always of zero hardness.

The capacity of a zeolite softener plant varies approximately in inverse proportion with the hardness of the raw water. If the zeolite apparatus is properly designed to take care of the owner's requirements of volume of water and hardness of raw water this is the most notable of advantages.

Relative Results Obtained in Precipitation and Zeolite Water-Softener Plants

Precipitation plants reduce the hardness of the water to 4 to 5 grains per gallon in the cold, and 2½ to 3 grains at boiling temperature. The reason for these limitations is to be found in the character of the reagents used and in the resulting reactions. In order to drive any chemical reaction to its limit an excess of the reagents is required. But since lime and soda ash are soluble reagents, this excess is found in solution in the treated water, and if too great, renders the treated water unfit for industrial or domestic use. Furthermore, some waters offer great resistance to the action of reagents. The resultant precipitates, calcium carbonate and magnesium hydroxide, sometimes form very slowly and remain in a colloidal condition and thus slip through the filters into the service lines. In the *Engineering News Record* of Jan. 13, 1920, this colloidal condition is reported in connection with the municipal precipitation plant of the City of Columbus, Ohio. A hardness of 100 p.p.m., or 6 grains per gallon, was found present in the softened water as a result of this colloidal condition. The precipitates themselves are also soluble to the extent of several grains per gallon, so that it is theoretically and actually impossible, even if the reactions could be driven to completion, to produce zero hardness water by the precipitation process.

Zeolite plants produce zero hardness water because the zeolite is insoluble and a great excess may therefore be employed without appearing in the softened water.

Comparative Cost of Operation of Precipitation and Zeolite Water-Softener Plants

The relative cost of the reagents used in the treatment by the precipitation and zeolite processes depends on the local market prices of hydrate of lime, soda ash and salt and also on the composition of the raw water.

The market prices today average about ¾c. per lb. for hydrate of lime; 2½c. per lb. for soda ash and ½c. per lb. for salt. One pound of hydrate of lime added to 1,000 gal. will react with about 8 grains per gallon of temporary hardness. One pound of soda ash added to 1,000 gal. will react with about 6 grains per gallon of permanent hardness. One pound of salt will regenerate a volume of zeolite that has softened a thousand gallons of water containing about 2 grains per gallon of either temporary or permanent hardness. Therefore for temporary hardness: 1 lb. lime at ¾c. reacts with 8 grains, or about ⅒c. per grain; 1 lb. salt at ½c. reacts with 2 grains, or about ¼c. per grain. Lime treatment is therefore half as costly as zeolite softening for temporary hardness. For permanent hardness: 1 lb. soda ash at 2½c. reacts with 6 grains, or about ⅓c. per grain; 1 lb. salt at ½c. reacts with 2 grains, or about ¼c. per grain. Soda ash treatment is therefore twice as costly as zeolite softening for permanent hardness. Waters therefore which contain equal amounts of temporary and permanent hardness can be treated at the same cost by either method. But as the permanent hardness rises in proportion to the temporary hardness present softening becomes more economical by the zeolite process.

In making the above calculations no account has been taken of the fact that softening with lime and soda ash leaves 4 to 5 grains of hardness in the treated water. For example, if the raw water has an average of 14 grains per gallon of hardness, of which 8 grains may be temporary and 6 permanent, the lime and soda ash cost of treatment is about 3¼c. per thousand gallons. But if 4 grains are left in the soft water, only 10 grains have been removed, so that per grain of hardness removed the cost is 0.325c. The same water would be totally softened by the zeolite process for about 2.8c. per thousand gallons, which establishes a cost of 0.2c. per grain of hardness removed.

Cases When the Combination of the Precipitation and Zeolite Processes Is Economical

Waters containing extremely high amounts of temporary hardness—for example, more than 25 grains per gallon—and at the same time containing relatively low amounts of permanent hardness—say, less than 10 grains per gallon—are economically treated as far as cost of chemicals are concerned by using lime and soda ash, but if in such cases the volume of water to be treated is fairly large the most economical treatment is obtained by combining the precipitation and zeolite processes, using the lime to reduce the temporary hardness and the zeolite to remove the permanent hardness and to finish the incomplete work of the lime. Thus one can select what is advantageous from both processes and at the same time produce a water of zero hardness.

[1] "A Comparison of Various Methods of Water Purification," W. M. Taylor, CHEM. & MET. ENG., vol. 24, No. 3, Jan. 19, 1921, p. 123.

The precipitation plant reduces a portion of the hardness and the pretreated water then passes to the zeolite plant, where the work of softening is completed. This also insures the reduction of the total solids of the water by the precipitation and removal of the greater part of the bicarbonates or temporary hardness. A number of combined lime-zeolite plants of this nature have been in operation in the United States for years.

Relative Influence of Various Factors on Foaming

It is falsely claimed that zeolite softened water increases the tendency of boilers to foam, on the consideration that the sodium salts have a heavier molecular weight by about 5 per cent than the corresponding calcium or magnesium salts. This is a chemical superrefinement inasmuch as the blowoff from the boilers maintains concentrations of total solids in the boiler salines considerably below the foaming concentration limit so that variations of 5 per cent in the total solids of the feed water are negligible by comparison.

Offsetting this possible 5 per cent increase in total solids is the very important fact that the water in a boiler fed with zero water is clear and free from particles of suspended scale and sludge or mud. And experience proves that the tendency to foaming is greatly increased by the presence of such suspended matter. This is illustrated also by the fact that when scaled boilers are suddenly fed with softened water, the scale which is loosened by the action of the soft water forms just such a suspension of particles and for a short period foaming is experienced. As soon as the boilers are thoroughly clean, however, they remain clean thereafter and the water inside the boiler clears up and the foaming ceases. A regular blowoff schedule can then be worked out to suit the operating conditions of the boilers in question, taking cognizance of the steam disengaging velocity and design of the boiler, all of which influence the limiting concentration of the boiler salines. Testing blowoff water with standard hydrometers should also be made standard practice to check up on the blowoff schedule.

Oil, organic and saponifiable matters are especially provocative of foaming. This is illustrated by a plant in Ohio using zeolite softened water in Sterling boilers of 1,000 h.p. total at high ratings with a water containing 25 grains per gallon total solids. No foaming was experienced during the summer on 100 per cent makeup, but in winter, when returns of 50 per cent from a heating system were used, foaming was observed. The returns lowered the solids in solution, but contained oily sludge previously deposited. As the heating system cleared up, this winter foaming disappeared.

Need of Zero Hardness Boiler-Feed Water

It is sometimes claimed that a feed water containing as much as 4 to 5 grains of hardness per gallon does not form a sufficient deposit in boilers to warrant consideration. Practical experience, however, proves that such a water is not satisfactory for boiler-feed purposes. When the statement is made that boiler compounds are good enough, that statement is linked with the past when the United States was an agricultural and not an industrial nation. Our national power requirements demand the highest degree of power plant operating efficiency. The time has passed when coal and oil were cheap and could be wasted. The recent war has demonstrated the ever-growing scarcity of fuel and the importance of conserving our natural resources.

The tendency today is toward boilers of ever-increasing size up to 1,000-hp. units operating with automatic stokers, at 200 to 300 per cent of normal rating and at very high pressures and superheat. This has developed an entirely new set of conditions.

Higher temperatures are being produced in the furnaces and far greater quantities of heat are being transmitted through the heating surfaces. Therefore greater care must be exercised in keeping the heating surfaces as clean as possible to avoid all danger of overheating the metal. Such immense boilers cannot be thrown off the line for repairs with the ease of former days. They are expected to run continuously for considerable periods without shut-down. What was good enough ten years ago with small boilers at low ratings, low pressure and low efficiency can no longer be countenanced. A water containing 5 to 6 grains per gallon of hardness in a 1,000-hp. boiler running at 300 per cent rating deposits in one day 220 lb. of scale on the inside of the boiler. In ten days more than a ton of scale would coat the heating surfaces. This certainly is not "good enough." The limit of hardness in the feed water must obviously come down to zero.

The Association of Central Power Plant Operators gave its opinion on this point in *Power* for June, 1916, in describing the results obtained from a water softener in a large central power station in New York operating on New York City's supply of 2 to 3 grains per gallon:

> The results obtained develop a fact that is of great interest—that scale will form where boilers are operated at such high rating as 200 per cent—if the water contains a hardness such as is usually obtained in the average water-softening plant. That is, boilers will not be free from scale if fed with a water of 4 grains hardness; therefore a greater refinement must be obtained to meet this condition. The demand for 200 per cent rating is growing as more and more plants are being built to operate at that rating and greater care will have to be taken to put into such boilers water containing the least possible hardness.

Conclusion

In conclusion, the use of boiler compounds for the treatment of boiler-feed water can no longer be recommended in view of the disadvantages resulting from this internal boiler water treatment. The recent demand for increased efficiency for boiler plants, the increase in the size of the boiler units being put into operation, and the tendency which has developed of increasing the rating at which the boilers are operated, make it especially necessary to keep the boilers free from any deposits. These same developments in boiler-operating practice have also created an unmistakable demand for a water as free from hardness as can be produced in order to maintain the heating surfaces perfectly clean.

The design of a water-softening plant to produce this zero hardness water depends on the composition of the raw water. If the hardness of the raw water is predominantly temporary in character and the amount of water to be treated is fairly large, the most economical type of treatment is the combination of lime-precipitation followed by zeolite water softening. If the proportion of the temporary hardness in the raw water is much below the proportion of permanent hardness present, straight zeolite treatment is to be preferred.

Frequently also, irrespective of the composition of the raw water, a preference has been clearly found to exist for the straight zeolite treatment due to its simplicity, certainty of action and freedom from the problem of sludge disposal, chemical feeding and after reactions common to precipitation water-softening plants.

Forest Products Laboratory Plans Work for the Year 1921-22

AS RECENTLY noted in the news columns of CHEMICAL & METALLURGICAL ENGINEERING, the appropriation for the coming year alotted to the Forest Products Laboratory, Madison, Wis., has been increased $100,000 for the year 1921-22.[1] New activities have been planned in the carrying out of research along present lines as noted in the following paragraphs:

WOOD MANUFACTURING WASTES

Of new work greatest emphasis will be placed on investigations to reduce the waste of two-thirds which now occurs in manufacture between the standing tree and rough, seasoned lumber, and of the further waste of from 10 to 15 per cent or even more in the remanufacture of rough lumber into final products. This means that approximately 75 per cent of the volume of every tree cut is wasted in manufacture before the final product is reached. High lumber prices and shortages of many important species of wood have made the question particularly acute.

The first phase of the problem to be undertaken will be to determine the possibility of cutting what is called dimension material—i.e., the exact sizes to be used in manufacture—direct from the log for furniture makers, wood turners and many other industries rather than first into lumber. For example, it is reported that in the manufacture of hickory handles two tons of material in the form of lumber is sometimes required to produce 400 lb. of handles, and in the furniture industry from 40 to 60 per cent of the lumber purchased is lost in various stages of manufacture. It is believed that manufacture directly into dimension material will materially reduce this waste. A systematic survey of waste which occurs in wood-using industries as contrasted with requirements will be undertaken in order that a market may be found in some industries for the waste in others. This is an exceedingly complex problem with great opportunity for saving. The possibility of a uniform system of lumber grading to replace the present multiplicity of systems will be studied in the interest of greater simplicity for the consumer, and second, to make possible the effective application of strength data, particularly in connection with municipal building codes.

PULP AND PAPER

Pulp and paper investigations will also be extended. Present processes employed in producing chemical pulps, which now use nearly 4,000,000 cords annually, convert less than 50 per cent of the raw wood into paper. An attempt will be made through research to reduce this enormous waste. Preliminary experiments indicate that increased yields can be obtained and that the wood now wasted can be saved and valuable chemical constituents reclaimed. Other preliminary investigations indicate the possibility under a modification of the sulphate pulp process of producing book and other high-grade paper from such resinous woods as Southern pine. The high prices now being paid by publishers and the great economic importance of making possible the utilization of a large amount of material now wasted justify this work on an enlarged scale. Fully $5,000,000 worth of pulp is now lost annually by decay and a still greater value of pulpwood decays through improper methods of handling. Investigations already under way to reduce this decay should be enlarged and continued. Twenty-thousand dollars of the proposed increase is needed for these urgent pulp and paper problems.

TIMBER TESTING

In timber testing it is desired to take up the development of methods for built-up and laminated construction, which offer great possibilities of utilizing small sizes and material now waste or of little value. Success for such articles as wagon parts and structural members depends upon comparative strength and permanence as compared with solid pieces, the development of improved glues or other satisfactory methods of fastening and a general industrial modification of existing standards and practice. The work is of particular urgency at the present time because of high prices and scarcity of high-grade material, and the difficulty in securing many kinds of timber formerly common.

The testing of large-sized columns will be undertaken. No data are now available on the strength of such columns, and it is necessary for safety to use considerably larger sizes than would be required if accurate strength data were available. A large amount of additional testing is necessary on wooden boxes and crates and fiber containers. The $55,000,000 paid by the railroad companies in 1918 in claims resulted largely from faulty containers, and this is only one phase of the loss from this cause for which the consumer pays. Tests are needed on a large number of containers representative of different classes of commodities. Also, the fundamental relationship of kind and thickness of wood, nailing and strapping of the container to the size and weight of the contents will be investigated. Such data will have an almost universal application in placing boxing, crating and packing on a sound technical basis.

WOOD DISTILLATION

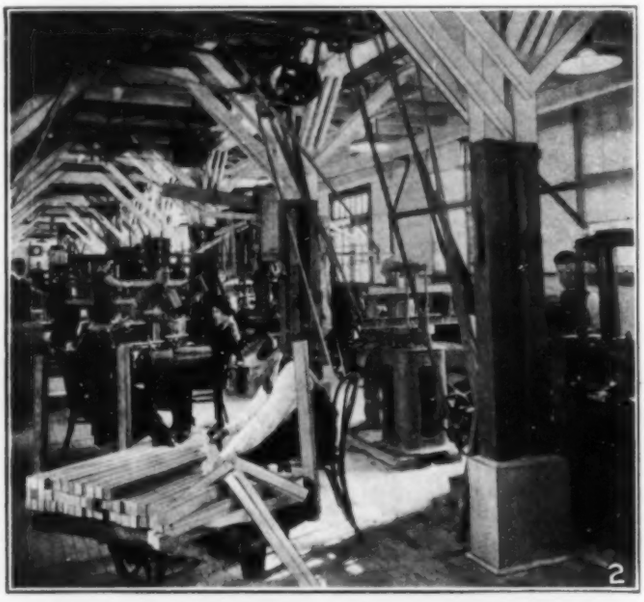
Chemical utilization offers probably the greatest opportunity of utilizing wood waste. In addition to work on pulp and paper problems, that on the manufacture of ethyl or industrial alcohol should be enlarged. Several millions of gallons of ethyl alcohol is now manufactured annually from wood in two plants in the United States. Investigations by the Forest Service have reduced operating costs at the larger of the two plants by 9c. a gal., and were an important factor in its success. Ethyl alcohol manufacture is important as a possible means of utilizing sawdust in mill waste, and the process offers a possible substitute for gasoline as fuel if through research production costs can be sufficiently reduced and manufacture made possible at small plants with low assembling costs. Investigations of hardwood distillation have increased the number of species which can be utilized from three to eight, have shown how without increasing operating costs yields of acetic acid and methanol can be increased 15 per cent, and more recently have shown how yields of methanol can be increased on an experimental scale by 50 per cent through the addition of one chemical. Since methanol can be obtained only from the distillation of wood, is essential in many basic chemical industries and can be made to utilize low-grade wood unsuitable for other purposes, the enlargement of investigations of this character is exceedingly desirable.

[1] See CHEM. & MET. ENG., March 30, 1921, p. 579.

Finally, much of the progress in all investigations of chemical utilization of wood will in the future depend upon a more advanced knowledge of the chemistry of wood. Additional work will therefore be undertaken into the fundamental chemistry of wood and its principal groups of constituents. The findings will be of immense value in pulp and paper making as well as in all of the other chemical industries which use wood as a raw material.

Drying Research

Improved methods of drying designed to reduce the largely unnecessary annual $50,000,000 loss in the seasoning of lumber have been developed on thirty-five woods, including Douglas fir, Southern pine, spruce,



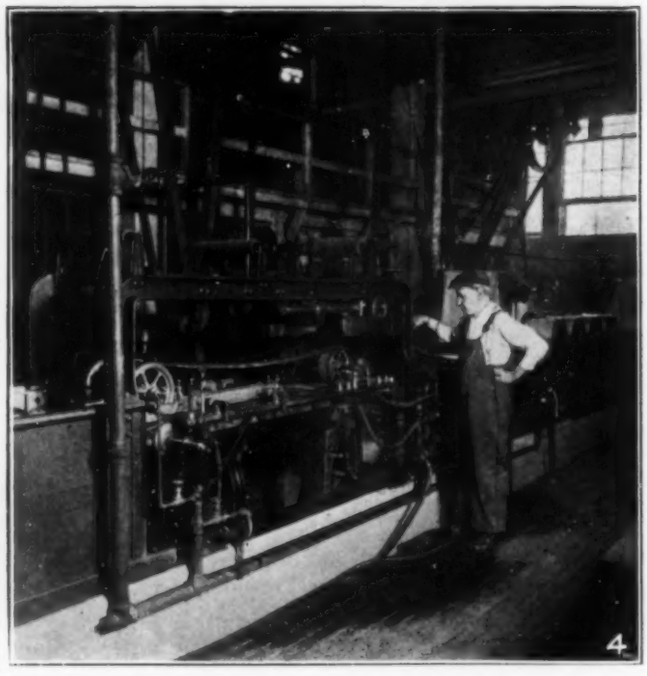


Fig. 1. Temporary quarters of timber testing department—The demands for information from the Forest Products Laboratory have been so great that this temporary building, formerly used as a war training barracks, was occupied. The tower in the foreground houses the 1,000,000-lb. universal testing machine recently installed. The double doors on either end can be opened to allow the testing of large members. Columns 30 ft. long and 12 in. square can be tested to destruction in this machine.

Fig. 2. Testing wood at a known moisture content—The strength of wood varies with the moisture content and the density (dry weight) of the piece. The importance of these two laws has been fully established by more than 500,000 separate tests of wood samples at the U. S. Forest Products Laboratory, Madison, Wis. From these tests and other data the density rules for grading Southern yellow pine and Douglas fir structural timbers were developed. This density rule provides a visual method of estimating the density of wood by relative proportions of springwood and summer wood (hard-growth rings and soft-growth rings) that shows on the end of a stick. The man in the foreground is marking a tested specimen for the moisture determination to be made by the girls in the immediate background. Moisture content is the difference between a given moisture condition and the oven-dry weight. The moisture content is dependent upon the atmospheric conditions of the place where the wood is stored.

Fig. 3. Erecting a million-pound testing machine—This million-pound capacity universal testing machine is to be used in studying full-size timbers. The influence of defects, such as knots, on strength is one of the important investigations contemplated. Columns 30 ft. long and 12 in. square can be tested to destruction in this machine. The part of the machine on which the man at the left is standing weighs 12 tons. The whole machine weighs 80 tons. The machine is of universal type, making tension and compression tests with equal facility.

Fig. 4. Experimental paper machine—This miniature machine can turn out a 16-in. strip of paper at the rate of 40 ft. a minute. It is equipped with both Fourdrinier and cylinder wet ends and it is used in determining the paper-making qualities of native woods. Such information is urgently needed at present on account of the rapidly diminishing supply of the woods commonly used for the manufacture of paper pulp.

gum and many of the oaks. Further improvement in methods must come through the determination of the limitations and possibilities of present types of dry kilns and their improvement, a wider knowledge of essential drying conditions for all our woods, and research into such fundamentals as the relation of moisture in the natural laws which govern the seasoning of wood. Present losses are an added production cost and also a wholly unnecessary drain on our forest resources, most of which can be eliminated by research.

Wood Preservatives

Further work is also planned on the development of various classes of wood preservatives. There is a large loss of timber in wharves, docks, etc., caused by marine borers. It is now possible to study the activities of these borers and to attempt the development of the preservatives only in the San Francisco Bay region, where conditions are particularly acute. The study will soon be extended to cover other points on the Pacific, Atlantic and Gulf coasts.

Efforts will also be made to develop a cheap, odorless preservative against wood decay suitable for wood used in exposed situations in such structures as houses, which will take paint and which can be supplied in quantity.

The accompanying photographs and descriptions give some idea of the equipment at the laboratory available for this work.

Cadmium in 1920*

By C. E. Siebenthal and A. Stoll

THE production of cadmium, either as the metal or as the sulphide, has been reported by the companies in the following list, which shows also the nature of the metallurgic plant in connection with which the cadmium plant is operated:

PRODUCERS OF CADMIUM IN THE UNITED STATES IN 1920

Company	Location of Plant	Associated Plant
American Smelting & Refining Co.	Denver, Col.	Lead smelter
Grasselli Chemical Co.	Cleveland, Ohio	Chemical works
Krebs Pigment & Chemical Co.	Newport, Del.	Lithopone plant
Midland Chemical Co.	Argo, Ill.	Lithopone plant
U. S. Smelting, Refining & Min. Co.	Kennett, Cal.	Electrolytic zinc plant
U. S. Smelting, Refining & Min. Co.	Midvale, Utah	Lead smelter

Of these the plant at Kennett, Cal., was reported to have made no output in 1920. The lead furnaces at the Globe plant of the American Smelting & Refining Co., at Denver, have been closed for some years, but stocks of cadmiferous residues remain from former operations and more has been shipped in from other plants of the company.

Many Plants Have Processes for Recovering the Metal

Several other electrolytic zinc plants and lithopone plants save cadmium-bearing residues and have worked out processes for recovering the metal, so that an extension of the uses of cadmium and an increased demand for it would result in additions to the list of producers. Several companies that produce cadmium-bearing residues sell them to the producing companies named above.

In 1918 a canvass was made of lead smelters, electrolytic zinc reduction and refining plants, lithopone plants, and a few typical brass works, with the object of ascertaining the yearly recovery of cadmium in fumes and residues, the accumulated stocks of such materials, and the maximum yearly capacity of the cadmium-reduction plants.

Cadmium Accumulating

According to the data obtained, cadmium is accumulating at lead smelters at the rate of 350 to 400 short tons annually, and the stocks of bag-house fumes contained more than 750 tons of cadmium. At electrolytic zinc plants about 200 tons is accumulating annually and the stocks of residues contained about 400 tons. At lithopone plants probably 50 tons is produced annually and about 25 tons was contained in stocks. In round numbers, then, 600 short tons accumulates annually, and there was on hand in 1918 approximately 1,200 tons in stocks of fumes and residues. Not all the stocks are rich enough for the cadmium to be commercially recovered, but perhaps material that carries 1,000 tons is suitable for treatment. The average recovery of cadmium is about 75 per cent. We may therefore estimate that 750 tons of recoverable cadmium in residues was in stock in 1918. At some electrolytic zinc plants the cadmium in the residues is wasted in recovering copper and lead.

Capacity for Metallic Cadmium

The maximum capacity for metallic cadmium reported by producers is 29,000 lb. a month, or about 175 tons a year. If the price of cadmium and the demand for it should justify expansion the producing capacity could no doubt be brought up with reasonable promptness to 500 short tons or more yearly. The price of cadmium will be the deciding factor also in determining what grade of cadmium fumes can be worked at a profit.

Uses for Cadmium

The alloys of cadmium most generally used are the easily fusible alloys used in the tips of automatic sprinklers, in safety plugs for boilers and in electric fuses; cadmium cliché metal for stereotype plates, and solders in which cadmium is substituted for part or all of the tin commonly used.

A fraction of 1 per cent of cadmium is used as a deoxidizer in making bronze telegraph and telephone wires and cables in France and Italy. The larger part of the cadmium exported from the United States goes to France. Cadmium is also used as a deoxidizer in making nickel alloys and may serve a like purpose in making brass.

A newer use for cadmium is in making small-arms ammunition. A cadmium band on the hard-jacketed cartridge ball takes the rifling with little wear on the barrel and thus prolongs the life of the gun.

Electroplating Offers Promising Field

Cadmium electroplating is a field that offers some promise of expansion. Cadmium is a better rust preventive than nickel, and at more nearly a parity in prices cadmium plating might be substituted for nickel plating on some articles. Or, as it has a greater tendency to tarnish than nickel, it might be used in combination with nickel, the first coat consisting of the rust-preventive cadmium and the second coat of the tarnish-proof nickel.

The Udylite Process Co., of Kokomo, Ind., has developed a commercial method for electroplating iron and steel articles with cadmium and is prepared to grant licenses for its use.

*Advance sheets; Mineral Resources, 1920, Part I.

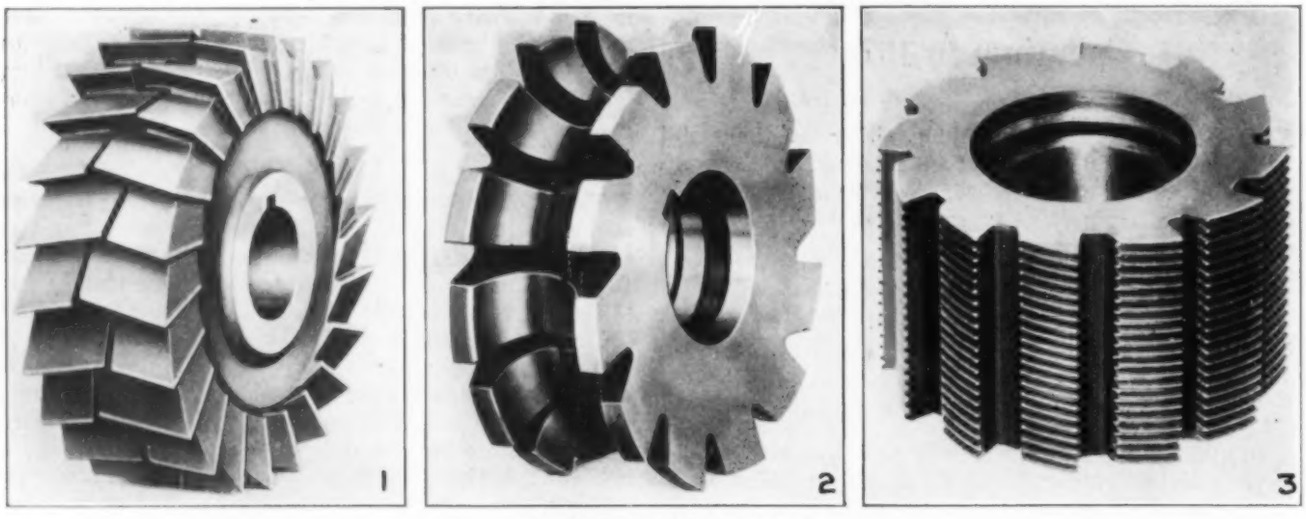
Heat-Treatment of High-Speed Steel Cutting Tools of Intricate Design

By A. J. Langhammer

MODERN manufacturing methods, especially where the principles of quantity production are applied, demand tools capable of continuous heavy duty performance. High-speed steel is the natural material from which such tools are made, and this article is limited thereto. Big production methods necessitate huge supplies of cutting tools. The specific type the writer has in mind is such cutting tools as taps, threading dies, hobs, broaches and special form cutters.

Attention is invited to the included photographs, Figs. 1, 2 and 3, of three special cutting tools. By an inspection of Fig. 2 it is at once obvious that any defect in the curved cutting edges greatly reduces the service of the tool, if it is not totally destroyed. In Fig. 1 this is not true to such a great extent. However, it is well known that no consumer will accept defective tools. Fig. 3, on the other hand, illustrates a type in which the tool hardener has little or no leeway. Such defects as pitting, deformation, dull or crushed edges absolutely incapacitate the tool. The importance of correctly heat-treating special cutting tools is therefore readily seen.

The machining of such special cutting tools offers no great difficulties—it is only in the hardening where trouble begins. In tool shops and large industrial plants one or both of two general hardening methods are used—i.e., "pack-hardening" or "open fire." By open fire is meant any method employing a muffle, or semi-muffle furnace, or a blacksmith's forge. Pack-hardening, of course, is used in the sense that is always understood, the packing material being carbonaceous material.



SPECIAL CUTTING TOOLS

The following advantages are claimed for each method by their proponents, and it will be noted that they are practically identical:

Pack-Hardening	Open-Fire Hardening
1-a—No scaling or pitting.	2-a—No scaling or pitting.
1-b—Little or no deformation.	2-b—Little or no deformation.
1-c—Absence of objectionable discoloration.	2-c—Maximum hardness (red-hardness).
1-d—Preserving of original sharp cutting edges.	2-d—Preserving of original sharp cutting edges.
1-e—Uniformity of product.	2-e—Uniformity of product.
1-f—Better cutting qualities.	2-f—Better cutting qualities.

For a number of years the writer has had occasion to observe the performance of cutting tools of intricate design made from the same brand of steel and even the same bar, where all precautions were taken to eliminate the variables affecting cutting speed and the only factor not a constant was that of the hardening method. Results have convinced him that the open-fire hardening method was undoubtedly the best, whenever the necessary care and skill was applied.

The reason for this is that in pack-hardening the temperature to which the tool is subjected is pure guesswork and is practically beyond control. Then, too, we have that important element—the time factor. When we consider that the heat-treatment of high-speed steel calls for a preheat of 1,450 deg. F. or thereabout, and then a *rapid heating* to exactly the "sweat point," the above statement is easily substantiated. Discoloration is somewhat under control by the tool hardener, and different brands of steel "clean up" better; however, pack-hardening generally gives a cleaner job, although with the open-fire method slight polishing, pickling, or sand blasting after quenching gives a superior product.

It should be noted, moreover, that the hardening of cutting tools of intricate design by the open-fire method is the acme of high-speed tool hardening. Only with the very best of care and closest attention are excellent results obtained. It is for this sole reason that the pack-hardening process was ever brought into practice. When the open-fire method is used, it is necessary to have a rich flame and all possibilities of oxidation must be eliminated. The temperature must be closely observed, and the tool quenched just before the "sweat point" is reached. The transfer of the tool from the furnace to quenching tank or lead pot must be quickly executed. Care must be exercised that no obstruction is met in the transfer, as the least impact will destroy the cutting edge. When this is done, the advantages listed as 2-a, 2-b, 2-d, 2-e and 2-f are obtained and in addition the most desirable one of maximum red-hardness. The writer has met one or two tool hardeners who regularly achieved good results with pack-hardening because of their uncanny skill. But this is the exception that merely proves the rule.

When an intricate cutting tool is correctly hardened by the open-fire method, it will permit greater cut speeds, longer periods between regrinds, produce a finer product, give a greater life, and therefore will yield a bigger production at reduced factory costs.

Detroit, Mich.

Legal Notes

By Wellington Gustin

Non-Delivery Under Installment Contract Not Justified by Non-Payment for Past Delivery

The liability of a manufacturer for failure to deliver agreed installments under a contract was the subject of an action before the Court of Appeals of Georgia, Smith versus Harrison et al., 106 S. E., 191. The court's rulings and holdings were substantially as follows:

In a contract of sale an obligation by the seller to deliver to the buyer by a certain date a gross quantity of a certain product for a certain estimated price, as 1,000 gross of glass containers at some agreed rate per gross, but which must be delivered in certain stipulated quantities periodically at certain designated periods, is entire, and a failure by him to make any one of the deliveries at the time agreed upon amounts to a breach of the entire obligation and gives to the buyer the right to elect to bring suit before maturity for such damages as he may have sustained by reason of such breach. (Phosphate Mining Co. vs. Atlantic Oil & Fertilizer Co., 93 S. E., 532.)

In such an action the buyer may recover such damages as he would have sustained by non-performance by the seller of his obligations upon their maturity—viz., the difference in the contract price and the market value at the time and place of delivery subject to a reduction (of damage) by any circumstances of which the buyer ought reasonably to have availed himself or did avail himself to reduce or mitigate his loss. And it is no defense to the seller and no ground for a reduction in the buyer's damage that the latter contracted for the product for a purpose not mentioned in the contract, and that he had no use for it, or that he failed to go into the market and buy elsewhere.

That where the seller defaulted in making a periodic delivery under the contract a demand by the buyer that the seller perform his obligation does not amount to a waiver by the buyer of his right to sue for the entire breach upon the seller's refusing to comply with such demand.

In the instant case the seller contended he had a right to refuse further deliveries under the contract because the buyer had failed to make payment for a past delivery. Assuming that the seller could so justify his refusal to make further deliveries, yet, says the court, since the parties to a contract may in the course of its execution depart from its terms and pay or receive money under such departure without any right in the other party to treat such departure as a violation or breach of the contract, in the absence of reasonable notice of his intention to do so given by the other party, the seller cannot, after having acquiesced in such departure and having failed to give such notice to the buyer, justify his refusal to comply with his obligation to deliver under the terms of the contract upon the ground that the buyer has failed to make payment for a past delivery.

Further it was claimed there was a tender of the product by the seller to the buyer. The contract provided that delivery was to be made at such place as the buyer may direct. Where no place is agreed on, under the statute sold goods must be carried to the person entitled to them, if residing within the state. There being nothing in the nature of the product or in the contract from which another place of delivery could be inferred in the absence of any direction from the buyer as to the place of delivery, to constitute a valid tender the product should have been carried to the buyer in person, but the carriage to his place of business, in his absence and without his knowledge, did not constitute a valid tender under the contract.

Judgment against the seller was affirmed.

When Mechanical Equipment Does and When It Does Not Become Fixtures

The manufacturers of chemical machinery are often confronted with the question of whether title to machinery sold by them and installed in plants may be retained, and whether attempts to retain are defeated by installing of the machinery. The question is a big one with many angles, and facts in any particular case might remove it from the operation of the rules as generally laid down.

Some propositions of the law involved came up in the recent decision in the action by the Atlantic Refining Co. against H. Flinberg to recover a tank, pump and equipment. Defendant claimed possession and title to the property, because after it was placed upon the land it became fixtures, and title passed when he purchased the real estate upon which the chattels had been placed by the company, the purchase of the real estate being made without notice that the seller had consented that the chattels should not become fixtures at the time of installation. Therefore, for lack of notice to him when he purchased the real estate, the equipment passed to him with the title to the real estate.

The company contended that defendant had notice or knowledge that the equipment was its property and therefore was not an innocent purchaser and for this reason it did not pass to defendant when he purchased the real estate.

The company brought its action in replevin. The court stated that the action of replevin lies for the possession of goods and chattels unlawfully detained from the owner or the person entitled to the possession thereof. The primary object of the action is the recovery of the property itself with damages for the taking and detention thereof. Secondarily, the object is the recovery of a sum of money equivalent to the value of the property.

The Law of Fixtures

In this case defendant claimed the equipment involved constituted what is known in the law as fixtures. The court says a fixture has been defined as a thing which, though originally a movable chattel, is, by reason of its annexation to land, regarded as a part of the land, partaking of its character and belonging, in the ordinary case at least, to the person owning the land. The owner of a chattel and the owner of land may agree that the annexation of the chattel to the land shall not change the legal character of the chattel or affect its ownership, and such an agreement is generally regarded as valid between the parties. Where, however, the land passes into the ownership of a third person, not a party to such an agreement and without notice or knowledge thereof, the purchaser of the land is not bound by such an agreement, but is entitled to the thing annexed to the land, as forming a part of the land. If any sub-

stantial part of the complete equipment necessary for the use of the chattels in question was fastened or attached to the freehold in a permanent manner, then all is to be considered as so attached and also everything used in working it.

Notice or knowledge on the part of the purchaser of real estate relative to an agreement respecting the title to fixtures on the premises purchased being in some person other than the owner of the real estate would be actual notice or knowledge of the fact or such information of a reliable character with respect to the ownership as would impose upon him the duty of making inquiry as to the actual ownership of the fixtures upon the land.

In the instant case the court said that if the purchaser, defendant herein, did not have notice, and was an innocent purchaser for value, then the title to the chattels would pass to him with the title to the land, but if he had notice and knowledge of the fact that the fixtures in question belonged to somebody other than the person from whom he purchased the land, then he would not be an innocent purchaser for value, and as between the true owner and himself the true owner would be entitled to the possession of the property.

Any notice, or knowledge of any fact, that would put him upon inquiry as to the ownership of the property would place a duty upon him to inquire and ascertain, if possible, the true owner; and the question of this notice or knowledge is ordinarily one of fact to be determined by a jury, where such fact is in dispute.

The court decided that defendant herein had such a notice and that therefore the equipment was not a fixture passing with the title upon the sale of the land.

Synopsis of Recent Chemical & Metallurgical Literature

A Theory on the Gradual Hydrolysis of Certain Salts.—The hydrolysis of salts being an ionic phenomenon, it would follow that such a reaction ought to be extremely rapid in all cases; but experience has proved that there are salt solutions whose hydrolysis is slow and may still continue even after many months. It has been found that all the salt solutions presenting this anomaly contain some of the acid or base in colloidal suspension; it would seem, therefore, that there is a relation of cause and effect between the presence of a colloid and the slow hydrolysis. A theory underlying this fact has been advanced by A. TIAN in a note presented before the French Academy of Sciences (*Comptes rendus*, May 9, 1921, pp. 1179-1181). He states that the extremely fine particles of the colloid unite to form grains of increasing sizes, which for a given mass present gradually decreasing surfaces, and that the hydrolysis of a salt is limited by two reactions, both of which reproduce the salt and the water with the acid or base freed during hydrolysis. The first reaction would take place in the aqueous phase between ions, this being exactly the reverse of hydrolysis. The second reaction, which he calls "supplementary retrogradation," takes place between the insoluble and liquid phases by the action of the other soluble element of the salt. The velocity of this reaction diminishes when the space between the two phases decreases and it follows that the hydrolysis slows down with the evolution of the colloidal solution. To prove this theory he has established experimentally that:

Slow hydrolysis is a function of the polymerization of the colloid and that there is effectively a regeneration of the salt by a reaction in which the colloid takes part. In the first case he has utilized the very interesting properties of gels which hinder the displacement of colloidal particles, and by using gelose, animal gelatine or silica to produce a solidified state he stopped the hydrolysis. In the second case he was able to vary the rate of the hydrolysis by varying the amount of the colloid.

Electrochemical Industries.—The June, 1921, issue of *General Electric Review* contains an article by JOHN A. SEEDE in which there is an interesting summary of developments in the electrochemical industries. Electrothermic applications such as those used for smelting, melting and refining of various metals and alloys are of increasing importance. The first electric furnaces for melting and refining steel when introduced about 1904 were generally regarded as laboratory curiosities. Today we have furnaces with three electrodes normally rated at 40 tons holding capacity and capable of pouring 65 tons. During this period brass-melting furnaces have been developed and their adoption has far outstripped that of steel furnaces.

The author classifies the products of the principal electrochemical industries into electrothermic and electrolytic products. The electrothermic products are alundum, calcium carbide, calcium cyanamide, carbon bisulphide, ferro alloys, graphite, iron, nitrates and nitrites, phosphorus and barium oxide. The electrolytic products include aluminum, caustic soda and potash, electrolytic iron, lead, magnesium, chlorine, chlorates and perchlorates, hydrogen and oxygen.

The following table lists these products with the approximate energy consumption required for their production. The author assumes the power to be furnished at $20 per horsepower-year and from this he derives the percentage of the market price represented by the cost of power. This power cost, which is obviously obtainable in but a few localities, is used throughout the calculations in order to obtain comparable data.

ELECTROCHEMICAL PRODUCTION COST OF VARIOUS MATERIALS

Material	Kw.-Hr. per Ton	Present Market Price of Product	Cost of Power per Ton	Per Cent Cost of Power to Market Price
Aluminum	30,000	$570	$90.00	15.80
Alundum	2,000	60	6.00	10.00
Barium oxide	1,200	*	3.60	*
Cadmium	2,500	2,200	7.50	3.40
Calcium carbide	4,000	80	12.00	15.00
Calcium cyanamide	3,750	300	11.25	3.75
Carbon bisulphide	850	160	2.55	1.60
Carborundum	8,500	*	25.50	*
Caustic soda 2,000 lb. Chlorine, 1,760 lb.	3,000	72 220	90.00	30.80
Copper (electr ly ic ref.)	300	240	.90	0.38
Copper (elec roly ic)	2,600	240	7.80	3.25
Ferrochromium (60%)	8,000	180	24.00	13.30
Ferromanganese (76%)	5,000	90	15.00	16.6
Ferromolybdenum (60%)	8,400	3,000	25.20	0.84
Ferrosilicon (50%)	5,000	80	18.00	22.50
Ferrosilicon (75%)	10,000	135	30.00	22.20
Ferrotungsten (70%)	7,600	700	22.80	3.25
Ferro-uranium (40%)	8,000	4,800	24.00	0.50
Ferrovanadium (35%)	6,800	3,500	20.40	0.58
Graphite	7,800	200	23.40	11.70
Iron (elec rothermic)	2,500	*	7.50	*
Iron (electro'y ic)	4,000	*	12.00	*
Lead	145	70	4.35	6.20
Magnesium	27,000	2,500	81.00	3.24
Nitric acid	17,500	*	52.50	*
Phosphorus	12,000	720	36.00	5.00
Potassium chlorate	1,350	150	4.05	2.70
Sodium	20,000	400	60.00	15.00
Sodium chlorate	7,000	170	21.00	12.30
Tin	175	570	0.525	0.09
Zinc	4,000	120	12.00	10.00

* Figures not available.

In like manner the second table compares the electrothermic melting and refining of a number of metals and alloys. The power cost is figured at 2c. per kw.-hr. throughout, and the percentages are, therefore, probably somewhat more in accord with actual practice.

ELECTROTHERMIC MELTING AND REFINING OF METALS

Material	Kw.-Hr. per Ton	Market Price per Ton: Raw Materials	Market Price per Ton: Product	Power Cost at 2c.	Per Cent Cost of Product
Aluminum	500	$570	$1,200	$10.00	0.80
Brass	300	200	600	6.00	1.00
Bronze	330	300	800	6.60	0.82
Cast iron	450	25	90	9.00	10.00
Cast steel	600	25	150	12.00	8.00
High-speed steel	750	400	1,500	15.00	1.00

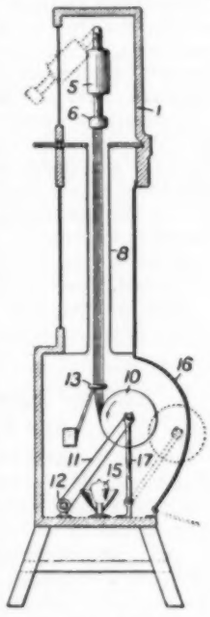
Recent Chemical & Metallurgical Patents

British Patents

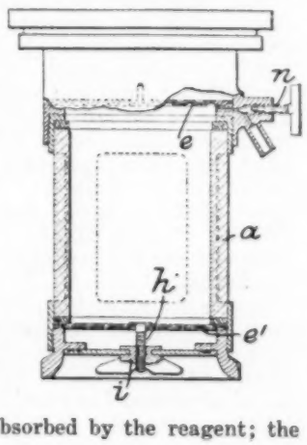
For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Monoazo Dyes.—Monoazo dyes are obtained by coupling *o*-diazophenols, *o*-diazonaphthols, or their nitro, sulphonic, or carboxylic derivatives, with 4:6-diamino-1:3-xylene. According to examples, the diazo compound of picramic acid, and the diazo compound of 5-nitro-2-aminophenol, prepared by diazotizing 2:4-dinitraniline in sulphuric acid solution and pouring the product into ice-cold sodium carbonate solution, are employed; the resulting dyes give orange-brown and brown shades on wool with chrome mordants. (Br. Pat. 160,848; G. T. MORGAN, Birmingham, and BRITISH DYESTUFFS CORP., LTD., London. May 19, 1921.)

Artificial Silk.—Artificial silk threads obtained by squirting a solution of cellulose acetate or other cellulose ester in a volatile solvent are prepared in a completely finished condition by passing the threads on leaving the squirting nozzle through gases or vapors such as sulphur dioxide, carbon dioxide or air which may be heated, or through an exhausted chamber, and then leading them directly to the winding or spooling apparatus. As shown, the parts of the apparatus are inclosed in a casing 1; in the top of the chamber is the combined squirting nozzle 6 and filter 5, arranged to swing outward, and the threads pass through a tube 8, then through a guide 13 traversed by the winding mechanism, or to a reel or spool 10 located in the lower part of the casing, mounted on a pivoted carrier 17, and driven by a belt 11, from a shaft 12; access to the reel is obtained by a door 16. In the lower part of the casing is an electric lamp 15 which causes a current of hot air to pass up the tube 8; and this tube may be warmed by a coil. The squirting nozzles may be located in the lower part of the casing, or the threads may be projected in a horizontal direction; and the threads may be stretched or twisted before reeling. (Br. Pat. 160,859; G. F. J. BOUFFE, Derby. May 19, 1921.)



Gas Analysis Apparatus.—An apparatus for analyzing gases comprises a receptacle *a* containing an absorbent for the constituent to be determined, the ends of the vessel being closed by diaphragms *e*, *e*¹, the first connected to a pressure-indicating device and the other diaphragm designed to be adjusted in position as by a screw *h* and nut *i* so as to control the inlet and exit of gas through a valve *n*. In use, a negative pressure is produced in the vessel by distending the diaphragm *e*¹, until the pointer makes a complete revolution; the valve *n* is then momentarily opened to admit a sample of gas; the final pressure shows the proportion of the sample absorbed by the reagent; the valve *n* is then opened and the diaphragm *e*¹ pressed inward to discharge the residual gas. (Br. Pat. 160,930; R. H. DAVIS and C. ROSLING, both of Westminster. May 25, 1921.)



Distilling Ammonia.—In stills for treating ammoniacal liquor to separate ammonia, which is used to form ammonium sulphate, in which the liquor passes down a primary still for separation of sulphuretted hydrogen and carbon dioxide, then into a liming chamber, and through a final still, a portion of the vapor is withdrawn from the liming chamber and passed through a reflux condenser to separate water, and into an ordinary condenser to obtain a concentrated solution of ammonia, which may be used to neutralize free acid in ammonium sulphate. (Br. Pat. 161,244; R. P. DOUGLAS, Bolton. May 25, 1921.)

Magnesium Chloride.—Oxygen compounds of magnesium are converted in the presence of sulphur or its non-oxygenated derivatives—e.g., sulphur chloride—into anhydrous magnesium chloride by the action of a chlorine containing gas. Preferably magnesia is used as the starting material, but the carbonate and sulphate of magnesium and the double carbonate or silicate of calcium and magnesium may also be employed. The reacting materials must be dry and substances capable of forming water must be absent. Until the last stage is reached the process is carried out below 700 deg. C. so that the product does not fuse and thereby impede the reaction. A little carbon is added when the chlorination is conducted at about 300 deg. C. to convert the small quantity of magnesium sulphate which is also produced, into magnesia. The latter is readily separated from the fusible chloride. Any apparatus for treating solids with gases may be used—e.g., the raw materials may be fed into the top of a cylindrical vessel and chlorine passed in at the bottom; the sulphur chloride and other condensable products being cooled and returned to the reaction-zone. Advantageously the process may be worked in conjunction with the electrolysis of the magnesium chloride, the hot chlorine from the latter being used direct for the chlorination. (Br. Pat. 161,165; not yet accepted; V. M. GOLDSCHMIDT, Christiania. May 25, 1921.)

Hardening Tools.—In hardening tools the tool is heated and hammered to form a skin or casing, again heated and placed in a mixture of potassium ferrocyanide and bone ash, whereupon the container is placed in a furnace and heated to bright redness. After a short time a further quantity of the powered mixture may be added. The tools are finally quenched in water, and large tools may be clamped between metal plates during coolnig. (Br. Pat. 161,446; W. TATE, South Hylton, near Sunderland. June 1, 1921.)

Heat-Treatment of Copper Alloys.—Relates to the heat-treatment of copper alloys and consists in subjecting alloys of copper, manganese and other metals such as aluminum, zinc, tin or silicon, after they have been cast, rolled or forged, to a prolonged heating at a temperature below red heat. In an example an alloy consisting of 10-15 per cent managanese, 10-15 per cent aluminum, the remainder being copper, which when rolled, annealed and cooled has a tensile strength of 66 kg. per sq.mm. and an extension of 21 per cent, after being subjected to a temperature of 220 deg. C. for twenty hours, showed a tensile strength of 96 kg. per sq.mm. and an extension of 0 per cent. The hardening is stated to render the metal suitable for the manufacture of knives. A marked hardening effect takes place in the case of brass alloys containing a high proportion of manganese. Such an alloy containing 51 per cent copper, 40 per cent zinc and 9 per cent manganese after rolling at a high temperature, forging and annealing at 600 deg. C. and cooling shows a tensile strength of 54 kg. per sq.mm., extension 11 per cent and a Brinell hardness of 166. After heating for thirty-six hours at 230 deg. C., the same alloy shows a tensile strength of 60 kg. per sq.mm., extension 2 per cent and a Brinell hardness of 260. Manganese, silicon and copper alloys hardened by this method at temperatures of 200 to 400 deg. C. may be used in place of tin alloys for bearing liners. Other examples are given in the specification. (Br. Pat. 161,537; not yet accepted; ISABELLEN HÜTTE GES., Dillenburg, Hessen-Nassau. June 1, 1921.)

Current Events
in the Chemical and Metallurgical Industries

Motion to Fix Standard of Comparison in M. S. Ltd., vs. Butte & Superior Co. Accounting Proceedings

On June 21 a motion of unusual nature was argued in this case before Judge Bourquin, U. S. District Court, sitting at Helena, Mont. By this motion, Minerals Separation, Ltd., seeks to have the court instruct the master, L. P. Donovan, who has recently been appointed in the Butte & Superior accounting, as to what shall constitute the standard of comparison for determining the amount of profits for which Butte & Superior company may be held liable as a result of the adjudged infringements.

In the case before the Supreme Court, Minerals Separation was not upheld in its contention that the process which Butte & Superior company had used (with oil in an amount in excess of 1 per cent upon the ore) was an infringement. Minerals Separation then claimed that petroleum was not "a frothing oil" upon defendant's ore, but the Supreme Court said that the patent made no disclosure as to "frothing oils" and held the plus 1 per cent process not to be infringing. Butte & Superior company took this plus 1 per cent process as a standard of comparison.

This motion, just argued, had as its announced object the prevention of extending the accounting proceedings beyond proper limits. Defendant sees in the motion an attempt to restrict it to water concentration as the sole standard of comparison.

Reference was made by plaintiff's counsel to the Miami accounting as being unduly prolonged, but it was explained by defendant's counsel that the Miami accounting—except for a brief period—had not been, thus far, an accounting at all, but that the time consumed had been almost entirely devoted to the examination of about eleven subsequent practices, in the use of which by the Miami company infringement was claimed by Minerals Separation.

Counsel for defendant, in argument, summarizes the contentions of the parties as follows:

The plaintiff sets forth in its hearing papers:

(1) That under the law, the only proper standard of comparison is a process or processes known and available at the date of the issuance of the patent in suit which would have given the best results with the defendant's ore if used by the defendant; and that in any event the standard of comparison must be a process or processes known and available prior to the commencement of infringement by the defendant.

* * * * * *

(4) That for the infringing acts of the defendant during the few days in January, 1917, after January 9, 1917, and the greater part of February, 1917, during which defendant infringed the patent in suit, the proper standard of comparison is water concentration.

(5) That for the infringing acts of defendant from some time in May, 1917, to and including June 5, 1919, the proper standard of comparison is water concentration.

The defendant in its answer says:

(1) The statement of law contained in the first paragraph of plaintiff's motion is neither accurate nor complete. Anything free and open to be used at the time of infringement is a proper standard of comparison, and defendant has the right, if it desires, not only to set up alternate standards of comparison but to introduce evidence going to the question of reasonable or established royalty, so that the court, after hearing the evidence submitted, may determine what measure of damages or profits best fits the facts of the case and is most just.

* * * * * *

(3) Defendant admits that all those forms of water concentration which were free and open to be used during the infringing period are available standards of comparison, but it denies that they are the only proper standards of comparison.

(4) Defendant further says that there are several standards of comparison available in this case, one of which has already been presented provisionally by defendant in its statement of account and another of which is the electrolytic process, and defendant asserts that it has the right to introduce evidence as to each and every available standard of comparison upon which it desires to rely, as well as evidence looking to the question of determining a reasonable or established royalty, and all other evidence germane to the issues.

(5) Defendant further says that there is no evidence in the case as to what is the best standard of comparison, and that the present motion is an attempt to have the court rule on the admissibility of evidence, before it has been tendered by the defendant. Defendant avers that the questions arising on this accounting in this connection are complicated and cannot be justly determined until all the evidence is in and a complete case made out.

Plaintiff's counsel asked the court to instruct the master on the law, to the effect that the standard of comparison must be a process known at the date of the invention. Defendant contended that the proper rule was that the standard must be known at the date of the infringement.

Counsel for defense further stated that there was record of only one instance in which the court had given preliminary instructions at this stage of the accounting, and that these instructions had been of a very general character, not at all like those asked for here; and further that the instructions were so modified by the accompanying explanation as to quite relieve the master, to whom they are addressed, from being in any way hampered.

Both parties are preparing briefs upon submission of which decision will shortly be rendered.

Stanley Patent Bill Goes Over in Senate for Further Consideration

So that a further report may be submitted by the Secretary of War, the Stanley patent bill, providing that foreigners shall manufacture within two years any article they patent in this country, has been allowed by the Senate to go over for further consideration. Frederick P. Fish of Boston, a patent attorney of national reputation, takes the position that the legislation would set up a bad policy and establish a dangerous precedent. In view of the objections from such an authority, Senator Stanley expressed his willingness to wait until the Secretary of War could have opportunity to reply to Mr. Fish's arguments.

Senator Stanley declared, however, that he is thoroughly convinced of the necessity of the legislation. He thinks the only effect it can have is to protect the Ordnance Department in a great number of patents that have been perfected by American engineers upon American ordnance. These same inventions, Senator Stanley says, which the Americans used during the war and are now using but which they did not patent, have been patented by foreigners and sold to the Krupps or other foreign concerns, with the result that we cannot use our own patents for our own defense. Senator Stanley also pointed out that the United States is the only country in the world that has no such legislation.

In the course of his remarks, Senator Stanley said that he is strongly of the opinion that the junking of patents should be prevented. He declared that this is one of the most fecund sources of corruption and of monopoly. He called attention, however, to the fact that nothing of that kind was attempted in this bill.

Fall Meeting, Cellulose Section, A.C.S.

The president and secretary of the American Chemical Society have authorized another meeting of the Cellulose Section in connection with the fall meeting of the parent society in New York, Sept. 6 to 10, 1921. Prof. Harold Hibbert has been reappointed chairman and Gustavus J. Esselen, Jr., secretary. This will be the fourth consecutive session devoted to cellulose and its derivatives, a symposium on the subjects having been held in both St. Louis and Chicago and the first meeting of the Cellulose Section, as such, at Rochester last April. At this last meeting great interest was shown and there is no doubt that the Cellulose Section has made a place for itself in the activities of the American Chemical Society.

It is the plan this year to issue the preliminary program much earlier than on previous occasions, and accordingly those who plan to present papers before the Cellulose Section are urged to send the titles at once to G. J. Esselen, Jr., secretary of the section, 248 Boylston St., Boston, 17, Mass.

Program of the Summer Meeting of the American Ceramic Society

The midsummer meeting of the American Ceramic Society will be held at Canton, Alliance, Sebring and East Liverpool, Ohio, July 25, 26 and 27, inclusive, with headquarters at the Hotel Courtland, Canton, Ohio. The advance program for trips at this meeting is as follows:

MONDAY, JULY 25

10 a.m.—Leave Hotel Courtland on special cars for the Dueber Watch Case Manufacturing Co.

12 Noon.—Return to hotel for luncheon.

1:30 p.m.—Take special cars for the Bonnot Co., manufacturer of clay machinery.

3 p.m.—Visit the Canton Stamping & Enameling Co. or the Republic Stamping & Enameling Co. Due to the limited time available, it will be impossible for members to visit both enameling plants, therefore this portion of the trip will be left open to individual choice.

5 p.m.—Return to hotel.

7 p.m.—Leave Hotel Courtland in automobiles for Congress Lake.

7:30 p.m.—Banquet Congress Lake Country Club.

The drive from Canton to Congress Lake is a very fine one over about eighteen miles of perfect brick pavement. The country club is one of the best in the country and the cool, refreshing breezes from the lake, combined with a delicious and appetizing menu and exquisite service, make this an ideal place to dine during a hot July evening.

Besides a few short after-dinner speeches by speakers of national reputation, there will be several unique entertainment features.

TUESDAY, JULY 26, AT ALLIANCE AND SEBRING

9 a.m.—Leave on special cars of the Stark Electric for Alliance, arriving at 10:10 at Mahoning Ave., where the party will be met with automobiles and taken direct to the No. 2 plant of the Alliance Brick Co. Here the members will have the opportunity to see one of the most modern equipped brick plants in the country, the bricks being burned in a Richardson compartment kiln with producer gas.

1 p.m.—A complimentary luncheon will be given at the Alliance Country Club by the ceramic industries of Sebring.

2 p.m.—Party will leave by automobile for Sebring, where the Limoges China Co., the Sebring Pottery Co. and the Strong Enamel Co. will be visited. The Dressler tunnel kilns at the Limoges China Co. and the McFall oil-burning equipment at the Sebring Pottery Co. will be of special interest to members.

5:45 p.m.—Return to Canton on special cars of the Stark Electric.

9 p.m.—Theatre party, Myers Lake.

10:30 p.m.—Complimentary smoker, Myers Lake.

WEDNESDAY, JULY 27, AT EAST LIVERPOOL

7 a.m.—Leave Hotel Courtland for East Liverpool in automobiles, arriving at about 10 a.m. Visit R. Thomas & Sons Co., high-voltage electrical porcelain factory, oil-burning kilns, tunnel drier.

11:45 a.m.—Complimentary luncheon at Elks Club.

12:45 p.m.—Visit Homer Laughlin China Co., Newell, W. Va., and Knowles, Taylor & Knowles Co., East Liverpool, Ohio, both general ware plants. The visit to the factories in East Liverpool will be concluded in ample time for members to take the 5:40 train to Rochester, Pittsburgh and the East. At Rochester, connections can be made with Pennsylvania train 115 for Chicago and the West.

ENTERTAINMENT FOR LADIES

Special plans for the entertainment of the ladies have been made by the committee. In addition to the visit to the Dueber Watch Works on Monday morning, the banquet on Monday evening, the complimentary luncheons on Tuesday and Wednesday and the theatre party on Tuesday evening to which the ladies are cordially invited, there will be automobile trips on Monday afternoon, Tuesday and Wednesday to places of interest.

AUTOMOBILE TRIP CANTON TO EAST LIVERPOOL

The automobile trip from Canton to East Liverpool is of special interest, as it is a drive over nicely paved roads and through beautiful country. All members within a radius of 200 miles of Canton are urged to bring machines in order that members from a distance may enjoy this most delightful trip.

Fellowships in Metallurgy at University of Missouri

In co-operation with the United States Bureau of Mines and the State Mining Experiment Station, the School of Mines and Metallurgy of the University of Missouri offers four fellowships. These fellowships are open to graduates who have the equivalent of a Bachelor of Science degree and have had the proper training in mining, metallurgy or chemistry, and who are qualified to undertake research work. The income of each fellowship is $800 per annum for the twelve months beginning July 1, 1921.

Fellows will register as students in the School of Mines and Metallurgy of the University of Missouri and become candidates for the degree of Master of Science in Mining or Metallurgy (unless this or an equivalent degree has been earned). Their class work will be directed by the heads of the departments of instruction, but the greater portion of their time will be spent in research work under the direction of the Bureau of Mines staff resident at the School of Mines. The purpose of this work is to undertake the solution of definite problems confronting the mining and metallurgical industries of the State of Missouri. For 1921-22 the four fellowships will be granted in the following subjects: Mining; ore dressing; physical metallurgy (heat-treatment of steel); electrometallurgy (zinc).

Applications, with a certified copy of collegiate record, statement of professional experience, and names and addresses of three references, will be received up to Sept. 1, 1921, by the Director, School of Mines and Metallurgy, University of Missouri, Rolla, Mo.

List of Research Chemicals in Preparation

Research chemicals and others not commonly available are to be listed in a forthcoming publication of the National Research Council. Dr. C. J. West, secretary of the committee, is sending out requests to every manufacturer of chemicals, stains, drugs and similar commodities asking them to furnish him with the list of products actually manufactured or products for which American companies are agents. This work will not include a listing of heavy chemicals or the more common chemical reagents, but it is intended to assist those doing research or occasionally using rare chemicals as raw materials to get in touch with all manufacturers of these products.

Special emphasis is being made by this committee on the importance of small orders. Where a company is willing to handle these, say in quantities less than 1 lb., this distinction will be indicated in the printed list.

Any manufacturers who have not already been reached by the committee should communicate with Dr. C. J. West, Committee on Research Chemicals, National Research Council, 1701 Massachusetts Ave., Washington, D. C.

Industrial Research Laboratories

Research facilities and the development activities of American industries are to be described in the forthcoming revision of bulletin of the National Research Council, No. 2, "Research Laboratories in Industrial Establishments of the United States of America." Only 300 such laboratories were listed in the first edition, but it is hoped that several hundred new names will appear in the revision and that a more nearly complete reference list will thus become available. The general demand for the first edition of the bulletin shows the wide interest in this subject and the importance of having every laboratory which devotes even a portion of its time to research properly listed.

The Council requests information from directors of research who have not already supplied it. The following data are wanted: Name and address of firm and address of laboratory; name of director of research; number on laboratory staff (classified as chemists, engineers, bacteriologists, etc.); approximate proportion of time spent on research; chief lines of research; unusual features of equipment; research laboratory space; date of organization of research laboratory and annual expenditure for research. Confidential information is not desired.

It is also requested that librarians in the service of the industries bring this notice to the attention of the proper officials in their organizations.

This material should be furnished as promptly as possible to the Research Information Service, National Research Council, 1701 Massachusetts Ave., Washington, D. C.

Dupont Fibersilk Co. Plant in Operation

Manufacture of artificial silk has been begun at the new plant of the DuPont Fibersilk Co. located on the Niagara River at Buffalo, N. Y. Operations are proceeding in a very satisfactory way and at the present time the plant is producing 1,000 lb. per day of 150 denier, which is one of the most widely used sizes of thread, but both the finer and coarser counts will be made in accordance with the demands of the trade. The product has already been tried out in several of the manufacturing industries using this size, such as those producing hosiery, fancy knitting, sweaters, neckties, broad silk weaving and others. The output of the plant will be increased from now on up to capacity, which will be in the neighborhood of 1,500,000 lb. of artificial silk per year. All of the product will be sold in the form of skeins and will go direct to manufacturers. When in full operation, the plant will employ approximately 600 operatives, about half of whom will be women.

The DuPont Fibersilk Co., which is a subsidiary of E. I. du Pont de Nemours & Co., owns 100 acres of ground on the Niagara River between Buffalo and Tonawanda and has installed its own facilities, including water supply, sewerage, etc. The DuPont Engineering Co. of Wilmington, Del., is the architect, engineer and designer for the plant and construction work was started in August, 1920. The buildings cover a total area of approximately 200,000 sq.ft. and are mostly one story in height. The main buildings are of brick, monitor type roof, glass sides and high head room, insuring ample light and proper ventilation. These main buildings are arranged so that the various processes of manufacture follow each other in proper sequence, thus insuring a minimum of handling. The balance of the buildings are concrete. The entire plant has been equipped with sprinkler system.

Power is supplied from a plant of 1,500 hp. which has been erected on the property and in addition to this, arrangements have been made to obtain electric power from one of the nearby electric power plants.

Special attention has been given to the comfort and convenience of employees and a modern cafeteria and girls' rest rooms have been provided. There are also medical and dental offices. Every effort has been made to insure the best of working and living conditions.

The DuPont Fibersilk Co. was incorporated in April, 1920, as a result of an agreement with the Comptoir des Textiles Artificiels of Paris, France. The latter company controls many of the large silk plants of Europe and has been producing artificial silk for many years. The DuPont Co. has done extensive experimental work during the past six years and has developed a fund of knowledge and experience which will help to make the product of the finest possible grade.

The officers of the DuPont Fibersilk Co. are L. A. Yerkes, president; B. M. May, treasurer; M. du Pont Lee, production manager; George Rocker, chemical director; E. K. Gladding, plant superintendent; C. J. Bacon, chief engineer.

The executive and sales offices of this company are located at Buffalo.

Insecticide and Disinfectant Manufacturers' Association, Atlantic City Meeting

The seventh mid-summer meeting of the Insecticide and Disinfectant Manufacturers' Association was held at Hotel Traymore, Atlantic City, June 13 and 14. President H. W. Cole of The Barrett Co. presided, and the special guests of the occasion were Dr. J. K. Haywood, chairman of the Insecticide and Fungicide Board, U. S. Department of Agriculture; Prof. Thomas J. Hedlee, Entomologist, State of New Jersey; and William D. Hartley, representative of McDougall Bros., Ltd., Manchester, England.

The address of welcome was given by A. L. Bobrick, president of the Sanitary Products Corporation of New York, chairman of the committee on publicity and program, and the response was by A. S. Hickerson, vice-president of the Worrell Manufacturing Co. of St. Louis.

The president's address, which opened the business of the meeting, reviewed the progress of the association during the past six months, especially in committees, and he expressed the appreciation of officers and committee chairmen for the hearty co-operation of the membership at large.

W. H. Gesell, of the Lehn & Fink Co., Inc., reported for the committee on disinfectants, which was followed by the report of the committee on insecticides, prepared by the committee chairman, R. N. Chipman, president of the Chipman Chemical Engineering Co. of New York, and read by C. L. Weirich, chief chemist. Mr. Bobrick submitted the report for his committee on publicity and program, after which Dr. William Dreyfus, chief chemist of the West Disinfecting Co., as chairman of the committee on standardization of disinfectants, reported for his committee and this report as submitted and accepted included the recommendation by the committee on the adoption of the Hygienic Laboratory method of testing disinfectants as received from Dr. G. W. McCoy and about to be published by the Hygienic Laboratory of U. S. Public Health Service.

Following luncheon Prof. Hedlee gave a most interesting talk upon his work as State Entomologist and set forth the possibilities his field presented to the trade.

Mr. Hartley then addressed the association informally in regard to trade conditions in England, especially with respect to exportations. When questioned as to the effect of the coal strike upon market values of creosotes, cresylics, etc., Mr. Hartley expressed the opinion that such supplies of coal had been furnished to the essential industries, including the gas and coal oven plants, and that an advance in prices of these products was not expected.

The reports of the officers and committees, combined with the interesting addresses given by the guests of the occasion, contributed to make the meeting a most successful one, and those in attendance were deeply impressed with the work the association was doing and its future prospects.

Standards Recently Approved by the A. E. S. C.

Standards recently approved by the American Engineering Standards Committee include four copper specifications submitted by the American Society for Testing Materials as "Tentative American Standard," as follows:

9—1921—Soft or annealed copper wire.

10—1921—Lake copper wire, bars, cakes, slabs, billets, ingots, and ingot bars.

11—1921—Electrolytic copper wire bars, cakes, slabs, billets, ingots and ingot bars.

12—1921—Battery assay of copper.

Exports and Imports of Chemicals

A further decrease in imports of chemicals occurred during May. The total value of imports during that month was $6,568,761. This is half the monthly average throughout the year preceding. The decrease is very marked when compared with imports in May, 1920, when their value aggregated $21,021,162. A decrease also is shown over April of 1921, when the value of imports totaled $7,416,478. The figures are those of the Bureau of Foreign and Domestic Commerce.

Colors and dyes formed the only item on the entire list of May's imports which showed an increase over the imports of May a year ago. Colors and dyes to the value of $307,735 were imported during May of this year, whereas the value of imports during May of 1920 was $263,281. Imports of coal-tar products, as a whole, decreased from $634,840 to $401,837. There was a decided slump in the gums imported. Imports in May of 1920 were valued at $5,714,192. In May of 1921 imports of gums were valued at $1,259,209. Outside the main groups, some of the chemicals imported during May, compared with the figures for the corresponding month of 1920, are as follows:

	May, 1920	May, 1921
Ammonia, muriate of	$79,077	$21,350
Glycerine	343,494	7,931
Lime, citrate of	761,277	676
Potash, nitrate of	122,748	15,341
Soda, cyanide of	41,935	12,392

Exports of chemicals were in small volume during May. The value of all chemicals exported during that month was $4,366,119. This compares with $4,525,852 in April, 1921, and with $18,030,514 in May of 1920. The decrease was general, as compared with exports in May of last year. Exports of acids declined from $840,282 to $97,983. Dyes and dyestuffs to the value of $3,437,885 were exported in May, 1920. In May of this year the value of exports was $396,524. Extracts for tanning declined from $260,118 to $75,277. In May of 1920 the exports of sodas were valued at $2,715,673. In May of this year the value of the soda exports was $435,037.

There was one item on the list which showed a very decided increase. In May of this year, 18,102,679 lb. of benzene was exported from the United States. This compares with exports of 1,483,096 lb. in May of 1920. Exports of certain chemicals which move in smaller volume are shown in the following comparative table:

	May, 1920	May, 1921
Copper, sulphate of	$38,619	$7,851
Formaldehyde	230,053	33,937
Glycerine	29,406	11,357

Chemists Exonerate Pyrites Plant from Fume Damage

M. R. Lamkey, plant physiologist, and Thomas F. Mains, plant pathologist, State Agricultural Experiment Station, Newark, Del., have tendered a formal report to the City Council, Wilmington, following an inspection of property at South Wilmington, held to have been damaged by fumes from the plant of the Pyrites Co., Ltd., in this section. The report sets forth that there is no absolute evidence that the damage was done by fumes or smoke from this plant, and while without any positive conclusion, it is attributed to severe frosts in the early spring. Referring to the fact that a month had elapsed before the investigation was made, due to neglect in calling on the station chemists, the report says: "We wish to emphasize the fact that many natural conditions can produce injuries so nearly similar to fumes or smoke injury that no investigation, no matter how expert, can distinguish the two after an exposure of several days to weather conditions. The injuries must be seen as they are produced, and the conditions under which they are produced must be known before a conclusive statement can be made."

New Stack at Midvale, Utah, Smelting Plant

The United States Smelting, Refining & Mining Co. has begun the construction of a new stack at its smelting plant at Midvale, Utah, to be 450 ft. in height and estimated to cost about $150,000.

Personal

PERCY E. BARBOUR, assistant secretary of the American Institute of Mining and Metallurgical Engineers, who has been seriously ill for some time past, is improving in health and expects to resume his duties before the end of July.

H. O. CHUTE, chemical engineer, of New York, is now associated with the Cannon-Swenson Co., Chicago, for work in wood distillation.

C. E. DAVIES has been appointed managing editor of *Mechanical Engineering*, the publication of the American Society of Mechanical Engineers, to succeed the late L. C. French.

Dr. LIVINGSTON FARRAND of the American Red Cross, Washington, D. C., has been elected president of Cornell University, Ithaca, N. Y.

ALEX. L. FEILD, who has been engaged in metallurgical investigations at the plant of the Electro Metallurgical Co., Niagara Falls, N. Y., has been recently transferred to the new research laboratory of the Union Carbide & Carbon Corporation, Thompson and Nelson Aves., Long Island City, N. Y. Mr. Feild was at one time assistant metallurgist in the U. S. Bureau of Mines, Pittsburgh, Pa., and later was research physical chemist with the National Carbon Co., Inc., Cleveland, Ohio.

H. O. HOFMAN, professor of metallurgy in the Massachusetts Institute of Technology, has been made an honorary member of the American Institute of Mining and Metallurgical Engineers.

A. G. MACGREGOR has returned from his inspection trip to the new Cerro de Pasco smelter in Peru. The plant will be ready to operate before next summer.

W. W. MURRAY, until recently manager at the plant of the Continental Can Co., Cannonburg, W. Va., has become connected with the staff of the same company at Chicago, Ill.

EMIL POHL, Hartford City, Ind., an expert in the manufacture of grease-proof glassine paper and for the past fifteen years superintendent of the super-calender department at the Hartford City Paper Mills, has resigned. He will occupy a similar position at a paper mill in Wisconsin.

CHARLES F. RAND, a director of the American Institute of Mining and Metallurgical Engineers, has been made an honorary member of the Iron and Steel Institute (London).

FRED F. SHARPLESS has been elected secretary of the American Institute of Mining and Metallurgical Engineers to succeed Bradley Stoughton, resigned.

L. B. SKINNER has recently severed his connection as chief of the research staff of the Mid-West Refining Co. to carry on a general consulting practice in Denver, Col.

Dr. E. R. WOLCOTT, of the Western Precipitation Co., Los Angeles, is on an extended Eastern trip on matters concerning electric precipitation.

Book Reviews

TREATISE ON GENERAL AND INDUSTRIAL ORGANIC CHEMISTRY. By *Dr. Ettore Molinari.* 456 pp. Philadelphia: P. Blakiston's Son & Co. Price $8 net.

The new edition of the Treatise on Industrial Chemistry should perhaps be more properly termed a treatise on organic chemistry in which the various compounds mentioned are selected with a view to their industrial application. The author points out the fallacies of other writers who deem that it is unnecessary for the student to be made familiar with the practical phase of the subject, claiming that a knowledge of theory is all that is required.

This conception in past years has been taken too literally, for today, when industry has attained an adult stage, the

author is justified in claiming that the time of the young technician cannot be wasted in a protracted and often sterile consideration of the theories involved.

In order to produce rapidly and with increased certainty a sound, practical man it is necessary to have a good theorist and to acquaint him with both a theoretical and practical study of the most salient industrial problems. In this book the author has endeavored to show the application of a great many organic compounds and has purposely left out of consideration a study of the industries themselves, thus making the book a reference volume on practical organic compounds, but at the same time he has pointed out possibilities for their further application and opportunities for the theorist as well as the technician to benefit from the matter therein contained.

This volume is an improvement on the former editions, and it is felt that the author should be congratulated upon the reception which the book has received. It is also felt that the book will be of great service to both manufacturers and chemists as an authoritative compilation of the important chemical compounds, presented in a comprehensive and readable manner. ALLEN ROGERS.

Current Market Reports

The Chemical and Allied Industrial Markets

NEW YORK, July 1, 1921.

There were no pronounced marks of interest shown in the chemical line during the past week. Only at intervals was there any positive character to trading and when prices moved, they did so in a perfunctory way. Changes were apt to be wholly fractional and the movement was as often a decline as an advance. The continued inactivity led to opinions that the market has gone as far as it can easily go in one direction, while others asserted that the absence of big buying orders was a result of the vacation spirit in the current holidays. It must be admitted that prices which rise under consumptive buying usually falter when orders of the sort are no longer obtainable. Not only are these particular orders absent when large buyers pursue this policy but traders and dealers who follow such a lead stop their own activities. These are possibly trivial considerations in a discussion of the chemical situation, but it is on such considerations that the present market is built up. In general, the market gave no clue as to what is coming next.

There are many buying interests that express the opinion that soda ash prices should be revised downward. These ideas can be traced directly to the fact that English and French ash has been offered through dealers at prices below those named by American producers. It is understood that these latter interests have not seen their way clear to quote lower on account of the relatively high overhead, freight and labor costs. The trade does not expect much change in caustic soda. The contract price is well sustained by producers and the supply of resale standard stock has been materially reduced in second hands where spot requirements are handled. The bichromates have not changed to any noticeable degree. Bichromate of soda varied about a half cent on spot during dull periods, but was not offered freely and the market was sensitive to small buying operations. Heavy importations of caustic, chlorate and carbonate of potash from Germany had a tendency to ease prices of these chemicals. Nitrite of soda was not active enough to permit a real test of values. Offerings of imported oxalic acid made a slight dent in the late advance in prices, although the tone was steady throughout the week.

FOREIGN INQUIRIES

Foreign inquiries have been noted from Italy, South America and other important points. Canada has bought quite moderately, but the inquiries seemed to be from those who were trying to feel the market. Prominent authorities who have just returned from South American ports admit that surplus stocks of chemicals are slowly but steadily decreasing. The establishment of a foreign credit system would give the necessary punch to export business and several large interests are confident that ways and means will be found to stimulate foreign commerce.

It seems to be the consensus among men occupying high places in business and finance in outside quarters that the tide is gradually turning for the better. It is generally agreed that sugar, copper, rubber, food and oil industries have seen their worst and are near the turning point. It may be said with a considerable degree of assurance that the cotton and leather industries are liquidated to the bone and are ready to recover. The woolen and textile trades are on the road to a general recovery. This is evidenced by reports of increasing business in mercantile lines throughout the country. Readjustments downward are expected to continue in labor, coal and steel and probably in the automotive trades. On the whole, it may be said that readjustment is now in its final stage. That which remains to be readjusted can undoubtedly be accomplished without disturbance to the general industrial fabric. It is well to consider that at the beginning of the year it did not seem possible that by this time prices for raw materials would have reached the point of approximate stabilization; that wage reductions would have been accepted by workers in widely diversified industries in the realization that they were just and necessary and finally that the banking position as a whole could have improved to the extent indicated by the substantial reduction in the borrowings of reporting member banks at the Federal Reserve banks. Borrowings, in general, have declined close to 50 per cent from the maximum reached last fall. Sentiment in regard to business will naturally fluctuate in times like these. The reaction from the spurt in spring business has caused profound disappointment. On the other hand, it is unwise to expect other than quiet business during the summer months.

CHEMICALS

An irregular weakness was noted in the market on *bichromate of soda* on spot, and a few small lots were disposed of below 8c. per lb. At the closing the feeling was somewhat steadier and prices ranged all the way from 8@8¼c. per lb., with 8¼c. the general quotation for standard goods ex-store. Trading has not shown much activity, and the slow inquiry inspired a keener state of competition among small holders in an effort to stimulate business. Quiet trading in spot *bichromate of potash* was reported by dealers during the past week at 11⅞@12¼c. per lb. Offerings continue limited on spot, but seem to be sufficient to cover the quiet extent of demand at present. There has been no material change in this chemical for several weeks. Imported *caustic potash*, 88-92 per cent, of German manufacture is on the market at prices ranging from 5@5½c. per lb., depending upon the quantity and seller. Dealers have placed an irregular business in this chemical and the price compares with 4½c. which was quoted just prior to the war when the market was recovering from one of the keenest trade wars ever experienced in this commodity. Foreign *chlorate of potash* has been offered in the local market on the basis of 7½@8c. per lb. and at 7c. per lb. for shipment from Germany, duty paid. At the close it was stated that this figure might be shaded on account of a decline in exchange rates. Prime American material continues unchanged at 12c. per lb. f.o.b. works. Resale *caustic soda* has been well sustained throughout the entire week at $4.10 per 100 lb. and upward for standard brands. Offerings have not been so plentiful and there was enough inquiry noted to keep prices firm. Demand has involved the wants of both domestic and foreign consumers and some sales for export went through at 4½c. per lb. Producers are firm on contracts at 3½c. per lb., basis 60 per cent, f.o.b. works. Large dealers of *nitrite of soda* have quoted the market at 7½@8c. per lb. on spot during most of the week. Small lots have changed hands below the inside figure and irregular business has been reported down to 7½c. per lb. The market is being carefully watched and holders have not lost confidence in price prospects. It is asserted that any permanent improvement in demand will likely find response in the course of values. Dealers in im-

ported *prussiate of soda* have quoted 12¼@12½c. per lb. on spot during the week, but it is stated that very little business took place below the outside figure. At the close an isolated lot might have been purchased at 12½c., but the market in most directions was quoted as steady at 12¼c. per lb. Small-lot transactions were about the best that could be noted in this market. Resale *soda ash* in single bags has been well maintained at $2.15 per 100 lb. and dealers have made sales at this figure and upward to $2.20, depending on quantity. Barrels have sold as high as 2¾c. per lb. in less than carload lots and down to $2.55 per 100 lb. in carlots. At the works prices held at $1.60 per 100 lb. for single bags, basis 48 per cent, and $1.95 per 100 lb. for barrels, basis 48 per cent.

Coal-Tar Products

Reports from various quarters of the coal-tar products market during the past week show different degrees of improvement, but on the whole a more active interest is noted among consumers and moderate sized lots are moving to meet requirements of the present and near future. The consuming demand for *paranitraniline* was very light and prices ranged from 85c.@$1 per lb., depending on seller and quantity. *Benzene* showed the same active conditions that have been noted for some time. Supplies seem to be quite limited and prices firm. The balance of the crude products were dull and only small quantities moved at irregular intervals. *Aniline oil* is moving in limited volume and prices are steady at 20@26c. per lb. *Beta naphthol* is firm at 38@40c. per lb. and fairly active. Supplies of dimethylaniline are limited, while the demand is fair and prices steady at 40@50c. per lb., depending on seller. *Metaphenylenediamine* was in fair request and supplies were quotably unchanged at $1.15@$1.20 per lb. The market on *benzaldehyde* is reported dull with only a routine business of small volume. Prices have shown no recent change, with the technical quoted at 45@50c. per lb. and the U.S.P. at $1.50 per lb. Reports from some quarters show an improvement in the consuming demand for *benzoic acid* with the U.S.P. moving on a basis of 60@65c. per lb. and the technical type at 50@60c. per lb. Available supplies are low. There has been very little change in the limited volume of business in *diphenylamine*, but the principal factors are steady in their views at 65c. per lb., while the low-priced resale lots are believed to be quite well absorbed. The past week has revealed little in *alphanaphthylamine* that could be construed as an improved outlook for an active market. There have been no changes in prices, however, which are quoted at 35@40c. per lb.

Vegetable Oils

Textile mills have been taking fair quantities of the technical grades of *castor oil*. Lubricant houses have not been active. In the U.S.P. grade the market was quiet but unchanged at 10c. per lb. Scattered parcels of *chinawood oil* sold in the past week at prices ranging from 14@15c. per lb. The offerings were comparatively light and quotations at all times were more or less nominal. Interest was noted in nearby stuff, but the ideas of buyers were somewhat below those of sellers. It was reported that 10¾c. might be done on July-August arrival at N. Y. For July-August shipment from the Orient 10¼c. could have been done. Closing prices in the market on *coconut oil* showed very little change compared with a week ago, yet the undertone in some directions was barely steady, due to a general lack of buying interest. Ceylon grade oil was unchanged on the spot at 10¼c. per lb. in barrels, with the Cochin type oil quoted at 11@11¼c. per lb. There was a firmer market for crude *corn oil* in the West in sympathy with the strength in other competing oils. Demand, however, for immediate shipment remained quiet. At the close holders were asking 5¾@6c. per lb. for shipment. Crude oil in N. Y. held at 7¼@7¾c. per lb. Further weakness in tallow did not help the *palm oil* situation. Exchange again was easier, but not so as to influence sellers, for closing prices showed little if any change compared with quotations of a week previous. *Lagos oil* for shipment was offered at 6¼c. per lb. c.i.f. N. Y. *Lagos oil* on spot was regarded steady at 7c. per lb. Holders of crude *peanut oil* throughout the South were rather firm in their ideas, yet a lack of importatnt buying checked attempts to advance prices. At the close prime oil was available at 6c. per lb., buyers' tanks, f.o.b. mill with strictly prime material at 6¼c. It was reported that scattered business went through at 6c. per lb.

The Chicago Market

CHICAGO, Ill., June 29, 1921.

There was a noticeable improvement in the tone of the industrial chemical market during the past two weeks. All quarters reported an increased volume of business, and while the quantities ordered are not large, the buyers are demanding immediate delivery, showing that supplies in consumers' hands are getting low. Prices as a rule are firm, with holders showing little or no disposition to cut. The small lots of foreign material on the market have had little effect on the domestic manufacturers, who seem to be holding their own.

General Chemicals

A firm tone still ruled in the market for *caustic soda*, although business was quieter. Supplies among second hands are small, and 4c. for solid 76 per cent and 4¾c. for the ground were the prevailing quotations. *Soda ash* is still very firm, and supplies could not be obtained under $2.60 per 100 lb. for material in barrels. *Sal soda* seems to be moving quite well at $1.65@$1.70 per 100 lb., although no large orders were reported. *Sal ammoniac* is unchanged as to price and is not moving so well. Prime white material, 98-100 per cent, is available at 8¼c. per lb. in single casks. *Blue vitriol* is very firm, with prices ranging from 6c.@7c. per lb. according to the holder and the package. A fair movement of *carbon bisulphide* was noted in some quarters and supplies were available at 7½c.@8c per lb. *Epsom salts* were in fair request and prices were firm at 3c.@3¼c. per lb. for the U.S.P. in barrels. *Formaldehyde* was very quiet and few sales were reported. Supplies are plentiful at 14c. per lb. for single barrels.

The *glycerine* market is very quiet, with little material moving. Offers as low as 15½c. per lb. were reported, but the prevailing price was 15¾c. for large drums. *Potassium bichromate* is quiet and steady, with a few small sales noted. Material of standard brand is offered at 14c@14½c. per lb. according to the seller. *Sodium bichromate* is not moving so well and supplies are available at 9c.@9½c. for single casks. *Bicarbonate of soda* is in fair request, and dealers are asking $2.65@$2.75 per 100 lb. for a good grade of material. *Hyposulphite of soda* is moving very well and the price is firm at $3.85 per 100 lb. *Sodium nitrite* is one of the firmest items on the list, and 9c. was the lowest offer noted.

Acids

As a rule the list of acids is quiet and unchanged. The demand for *citric acid* is rather disappointing for this time of year, and in some quarters supplies are heavy. Second hands are quoting as low as 45c. in some instances. *Oxalic acid* is quiet, and supplies are available at 18c@20c. per lb. *Tartaric acid* is weak, and offerings at 32c. per lb. were heard. The heavy acids are quiet and unchanged as to price. *Sulphuric*, 66 deg., is quoted by makers at $19@$20 per ton in tank cars f.o.b. works.

Vegetable Oils

This market has shown more life during the past week than for several months. One dealer describes his business in *linseed oil* as fine, while several factors report a very good volume. In 10-bbl. lots or over the boiled oil is available at 80c. per gal., with a corresponding reduction for the raw.

Naval Stores

This branch of the trade has shown a decided change for the better and conditions are about all that could be expected. There is a good movement of turpentine and less than carlots are quoted at 60c. per gal., drum basis. The *rosins* are moving in a fair way, and prices are firm, with less than carlots quoted at $6.60 per 280 lb. for the "G" grade. *Rosin oil* is also in fair request, and is offered at 45c. per gal. in barrels.

The Iron and Steel Market

PITTSBURGH, July 1, 1921.

The steel market has become still quieter, the absence of buying being almost complete, at least as regards the mills. There is more support to the theory that some of the buying is intercepted by manufacturing consumers reselling what stocks of steel they have remaining. There is evident a desire on the part of all consumers or distributors to reduce stocks not to the possible minimum but to absolute zero. The precise motive is not clearly understood, whether a fear that prices will decline greatly or a desire to be without stocks for an indefinite period. As in resales the mill market must be greatly undersold, the prospect of a further decline in steel prices is not necessarily a sufficient reason. Support to the theory that reselling is an important factor in reducing the demand on the mills is the fact that mills find demand for merchant steel bars especially light among steel products in general, and bars are a commodity that are normally stocked in considerable quantities, while stocks are mobile, since a consumer can generally be found for any ordinary section or size of bar.

DECLINING TENDENCY IN STEEL PRICES

There is a generally declining tendency in steel prices, but the fortuitous or occasional declines are of no great interest, while in the majority of commodities there is really no stable market price at any given time. There is so little business that while there is competition there is not enough to develop clear cut prices. The trade at large is not interested so much in current prices as in prospective prices, for it is generally understood that a definite price level will be furnished by the mills when they see that buying of any consequence is ready to occur and the buyer in his turn feels that he must be assured that he will not gain by deferring his purchase.

To illustrate the attitude, it is not uncommon for the buyer to ask the mill to guarantee a price to date of shipment of the steel, which is something the mills will not do, but if that is the mental attitude of the manufacturing consumer it is obvious that he thinks still more of the time that must elapse between the date of shipment of the steel and the date of sale of the goods he intends making from the steel, and at this time he cannot sell his product ahead. He does well if he makes sales out of stock already produced.

NEW STEEL CORPORATION PRICE SCHEDULE PREDICTED

In some quarters it is predicted that within a few weeks the United States Steel Corporation will announce a schedule of prices so low that it will be accepted as the minimum that buyers can expect, at least for a period of months, but this would be done only in case it seemed clear that there was a latent demand to be developed by price reduction. Up to this time the mills have claimed, with good show of reason, that buyers were not ready to take hold, no matter what prices were quoted.

The so-called "April prices" are down $5 a ton in wire products and sheets, as noted in previous reports. Other steel commodities are being shaded more or less from the April schedule, but there is no formal announcement that the Steel Corporation has made departures other than in wire products and sheets. It is just learned that the corporation recently reduced the galvanizing differential in wire from 70c. to 50c. per 100 lb., so that with plain wire at 2.75c. galvanized wire is 3.25c., and with painted barb wire at 3.15c. galvanized barb wire is 3.65c. Nails are at $3, as formerly announced.

PIG IRON AND COKE

Pig iron is practically nominal at last week's quotations: Bessemer, $22.50; basic, $20.50; foundry, $31.50 f.o.b. valley furnaces, with $1.96 freight to Pittsburgh. On an attractive inquiry these prices could be shaded, as with continued light absorption of stocks and prospects of the replacement cost decreasing furnaces are more anxious to liquidate.

Connellsville coke for spot shipment remains quotable at $3 for furnace and $4.25 to $4.75 for foundry. On an attractive inquiry the furnace coke price could probably be shaded.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots	Less Carlots
Acetic anhydride	lb.	- -	$0.40 - $0.45
Acetone	lb.	$0.12½ - $0.12½	.13 - .13½
Acid, acetic, 28 per cent	100 lbs.	2.50 - 2.75	3.00 - 3.25
Acetic, 56 per cent	100 lbs.	4.00 - 4.25	4.50 - 5.50
Acetic, glacial, 99½ per cent, carboys	100 lbs.	9.75 - 10.00	10.25 - 10.50
Boric, crystals	lb.	.13½ - .14	.14½ - .15
Boric, powder	lb.	.15 - .15½	.16 - .16½
Citric	lb.	- -	.46 - .47
Hydrochloric	100 lb.	1.50 - 1.65	1.75 - 2.00
Hydrofluoric, 52 per cent	lb.	.12½ - .13	.12½ - .13
Lactic, 44 per cent tech	lb.	.10 - .11	.11½ - .12
Lactic, 22 per cent tech	lb.	.04½ - .05½	.06 - .07
Molybdic, C. P.	lb.	4.00 - 4.50	4.50 - 5.00
Muriatic, 20 deg. (see hydrochloric)		- -	- -
Nitric, 40 deg	lb.	.06½ - .06½	.07 - .07½
Nitric, 42 deg	lb.	.07 - .07½	.07½ - .07½
Oxalic, crystals	lb.	.18 - .18½	.19 - .20
Phosphoric, 50 per cent solution	lb.	.13½ - .14	.14½ - .18
Picric	lb.	.20 - .25	.27 - .35
Pyrogallic, resublimed	lb.	- -	1.90 - 2.15
Sulphuric, 60 deg., tank cars	ton	- -	12.00 - 14.00
Sulphuric, 60 deg., drums	ton	- -	13.00 - 15.00
Sulphuric, 66 deg., tank cars	ton	18.00 - 20.00	- -
Sulphuric, 66 deg., drums	ton	21.00 - 22.00	22.50 - 23.00
Sulphuric, 66 deg., carboys	ton	- -	- -
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	21.00 - 22.00	- -
Sulphuric, fuming, 20 per cent (oleum) drums	ton	23.00 - 23.50	24.00 - 24.50
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 - 32.00	33.00 - 34.00
Tannic, U. S. P.	lb.	- -	.90 - 1.00
Tannic (tech.)	lb.	.45 - .48	.50 - .55
Tartaric, crystals	lb.	- -	.29 - .30
Tungstic, per lb. of WO	lb.	- -	1.30 - 1.40
Alcohol, Ethyl	gal.	- -	4.90 - 5.05
Alcohol, Methyl (see methanol)		- -	- -
Alcohol, denatured, 188 proof	gal.	- -	.31 - .36
Alcohol, denatured, 190 proof	gal.	- -	.38 - .42
Alum, ammonia lump	lb.	.03½ - .03½	.04 - .04½
Alum, potash lump	lb.	.03½ - .04	.04 - .04½
Alum, chrome lump	lb.	.13 - .13½	.14 - .14½
Aluminum sulphate, commercial	lb.	.01½ - .02	.02 - .02½
Aluminum sulphate, iron free	lb.	.02½ - .02½	.03 - .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.07 - .07½	.07½ - .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 - .32	.33 - .35
Ammonium carbonate, powder	lb.	.08 - .08½	.09 - .10
Ammonium chloride, granular (white salammoniac)	lb.	.06½ - .06½	.07 - .07½
Ammonium chloride, granular (gray salammoniac)	lb.	.07½ - .08	.08 - .08½
Ammonium nitrate	lb.	.07 - .07½	.07½ - .08½
Ammonium sulphate	100 lb.	2.60 - 2.75	2.80 - 3.00
Amylacetate	gal.	- -	4.00 - 4.25
Amylacetate tech	gal.	- -	2.50 - 3.00
Arsenic oxide, (white arsenic) powdered	lb.	.06½ - .07	.07½ - .08
Arsenic, sulphide, powdered (red arsenic)	lb.	.11 - .11½	.12 - .13
Barium chloride	ton	59.00 - 59.50	60.00 - 62.00
Barium dioxide (peroxide)	lb.	.20 - .21	.22 - .23
Barium nitrate	lb.	.07½ - .07½	.08 - .08½
Barium sulphate (precip.) (blanc fixe)	lb.	.04½ - .05	.05½ - .06
Bleaching powder (see calc. hypochlorite)		- -	- -
Blue vitriol (see copper sulphate)		- -	- -
Borax (see sodium borate)		- -	- -
Brimstone (see sulphur, roll)		- -	- -
Bromine	lb.	.41 - .42	.43 - .45
Calcium acetate	100 lbs.	2.00 - 2.05	- -
Calcium carbide	lb.	.04½ - .04½	.05 - .05½
Calcium chloride, fused, lump	ton	23.50 - 24.00	24.50 - 25.50
Calcium chloride, granulated	lb.	.01½ - .02	.02½ - .02½
Calcium hypochlorite (bleach powder)	100 lb.	2.15 - 2.25	2.35 - 2.50
Calcium peroxide	lb.	- -	1.40 - 1.50
Calcium phosphate, tribasic	lb.	- -	.15 - .16
Camphor	lb.	- -	.75 - .78
Carbon bisulphide	lb.	.06½ - .07	.07½ - .08
Carbon tetrachloride, drums	lb.	.10½ - .10½	.11 - .12
Carbonyl chloride (phosgene)	lb.	- -	.60 - .75
Caustic potash (see potassium hydroxide)		- -	- -
Caustic soda (see sodium hydroxide)		- -	- -
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.08 - .09	.09½ - .10
Chloroform	lb.	- -	.40 - .43
Cobalt oxide	lb.	- -	3.00 - 3.10
Copperas (see iron sulphate)		- -	- -
Copper carbonate, green precipitate	lb.	.20 - .21	.22 - .23
Copper cyanide	lb.	- -	.50 - .62
Copper sulphate, crystals	lb.	.05½ - .06	.06½ - .06½
Cream of tartar (see potassium bitartrate)		- -	- -
Epsom salt (see magnesium sulphate)		- -	- -
Ethyl Acetate Com. 85%	gal.	- -	.85 - 1.00
Ethyl Acetate pure (acetic ether 98% to 100%)	lb.	- -	.50 - .52
Formaldehyde, 40 per cent	lb.	.13½ - .14	.14½ - .15
Fusel oil, ref.	gal.	- -	3.00 - 3.25
Fusel oil, crude	gal.	- -	1.75 - 2.00
Glauber's salt (see sodium sulphate)		- -	- -
Glycerine, C. P. drums extra	lb.	- -	.16 - .16½
Iodine, resublimed	lb.	- -	3.65 - 3.75
Iron oxide, red	lb.	- -	.10 - .20
Iron sulphate (copperas)	ton	19.00 - 20.00	21.00 - 22.00
Lead acetate	lb.	- -	.11½ - .13½
Lead arsenate, paste	lb.	.09 - .09½	.10 - .11
Lead nitrate	lb.	- -	.15 - .20
Litharge	lb.	.08½ - .08½	.08½ - .09
Lithium carbonate	lb.	- -	1.30 - 1.40
Magnesium carbonate, technical	lb.	.09 - .09½	.10 - .11
Magnesium sulphate, U. S. P.	100 lb.	2.40 - 2.75	- -
Magnesium sulphate, technical	100 lb.	- -	1.20 - 1.75
Methanol, 95%	gal.	- -	.77 - .80
Methanol, 97%	gal.	- -	.80 - .85
Nickel salt, double	lb.	- -	.14 - .14½
Nickel salt, single	lb.	- -	.15 - .15½
Phosgene (see carbonyl chloride)		- -	- -
Phosphorus, red	lb.	.45 - .46	.47 - .50
Phosphorus, yellow	lb.	- -	.35 - .37
Potassium bichromate	lb.	.11½ - .12	.12½ - .12

		Carlots	Less Carlots
Potassium bitartrate (cream of tartar)	lb.	$.... – $....	$0.30 –$0.31
Potassium bromide, granular	lb.	.... –	.16 – .25
Potassium carbonate, U. S. P.	lb.	.35 – .40	.45 – .50
Potassium carbonate, 80–85%	lb.	.05 – .05½	.06 – .07
Potassium chlorate, crystals	lb.	.07½– .07¾	.08 – .12
Porassium cyanide	lb.	.... –	.26 – .28
Potassium hydroxide (caustic potash)	lb.	.05 – .05¼	.05½– .06
Potassium muriate, 80% K.C.l.	ton	49.00 – 50.00	.... – ....
Potassium iodide	lb.	.... –	2.75 – 3.00
Potassium nitrate	lb.	.09½– .09¾	.10 – .12½
Potassium permanganate	lb.	.29 – .30	.31 – .32
Potassium prussiate, red	lb.	.35 – .37	.38 – .40
Potassium prussiate, yellow	lb.	.24½– .25	.25½– .26
Potassium sulphate (powdered)	per unit	.... –	1.50 – 1.75
Rochelle salts (see sodium potas tartrate)	....	....	.... – ....
Salammoniac (see ammonium chloride)	....	....	.... – ....
Sal soda (see sodium carbonate)	....	.... –	.... – ....
Salt cake	ton	.... –	27.00 –30.00
Silver cyanide	oz.	.... –	1.35 – 1.38
Silver nitrate	oz.	.... –	.40 – .41
Soda ash, light	100 lb.	2.15 – 2.20	2.30 – 2.70
Soda ash, dense	100 lb.	2.40 – 2.45	2.50 – 2.75
Sodium acetate	lb.	.04½– .04¾	.04¾– .05¼
Sodium bicarbonate	100 lb.	2.25 – 2.40	2.50 – 2.75
Sodium bichromate	lb.	.08 – .08½	.08½– .09
Sodium bisulphate (nitre cake)	ton	5.00 – 5.25	5.50 – 6.50
Sodium bisulphite powdered, U.S.P.	lb.	.05 – .05½	.05½– .06
Sodium borate (borax)	lb.	.06 – .06½	.06½– .07
Sodium carbonate (sal soda)	100 lb.	1.90 – 2.00	2.10 – 2.40
Sodium chlorate	lb.	.07½– .07¾	.08 – .08½
Sodium cyanide	lb.	.19½– .21	.22 – .30
Sodium fluoride	lb.	.11½– .12	.12½– .13½
Sodium hydroxide (caustic soda)	100 lb.	4.15 – 4.25	4.30 – 4.80
Sodium hyposulphite	lb.	.... –	.03½– .03¾
Sodium nitrate	100 lb.	2.80 –	3.00 – ....
Sodium nitrite	lb.	.07½– .07½	.07½– .08
Sodium peroxide, powdered	lb.	.25 – .26	.27 – .30
Sodium phosphate, dibasic	lb.	.04½– .04¾	.05 – .05½
Sodium potassium tartrate (Rochelle salts)	lb.	.... –	.26 – .27
Sodium prussiate, yellow	lb.	.12½– .12¾	.13 – .13½
Sodium silicate, solution (40 deg.)	lb.	1.00 – 1.15	1.25 – 1.40
Sodium silicate, solution (60 deg.)	lb.	.02½– .03	.03½– .03¾
Sodium sulphate, crystals (Glauber's salt)	100 lbs.	1.50 – 1.75	2.00 – 2.25
Sodium sulphide, fused, 60–62 per cent (conc.)	lb.	.05½– .05¾	.06 – .06½
Sodium sulphite, crystals	lb.	.03½– .04	.04½– .04½
Strontium nitrate, powdered	lb.	.15 – .15¼	.16 – .17
Sulphur chloride, red	lb.	.07 – .07½	.07½– .08
Sulphur, crude	ton	20.00 –22.00	.... – ....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	.... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	.... –	2.00 – 2.75
Tin bichloride, 50 per cent.	lb.	.18 – .19	.... – ....
Tin oxide	lb.	.... –	.40 – .42
Zinc carbonate, precipitate	lb.	.16 – .18	.19 – .20
Zinc chloride, gran.	lb.	.11 – .11½	.11½– .12
Zinc cyanide	lb.	.45 – .49	.50 – .60
Zinc dust	lb.	.11½– .11¾	.11¾– .12½
Zinc oxide, XX	lb.	.09 – .09½	.09½– .10
Zinc sulphate	100 lb.	2.90 – 3.00	3.25 – 3.75

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude	lb.	$1.10 — $1.15
Alpha-naphthol, refined	lb.	1.25 — 1.30
Alpha-naphthylamine	lb.	.35 — .40
Aniline oil, drums extra	lb.	.20 — .27
Aniline salts	lb.	.26 — .29
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.50 — ....
Benzidine, base	lb.	.85 — 1.00
Benzidine sulphate	lb	.75 — .85
Benzoic acid, U.S.P.	lb.	.60 — .65
Benzoate of soda, U.S.P.	lb.	.55 — .60
Benzene, pure, water-white, in drums (100 gal.)	gal.	.27 — .32
Benzene, 90%, in drums (100 gal.)	gal.	.25 — .28
Benzyl chloride, 95-97%, refined	lb.	.28 — .30
Benzyl chloride, tech	lb.	.20 — .25
Beta-naphthol benzoate	lb.	3.50 — 4.00
Beta-naphthol, sublimed	lb.	.70 — .75
Beta-naphthol, tech	lb.	.38 — .40
Beta-naphthylamine, sublimed	lb.	1.75 — 1.80
Cresol, U. S. P., in drums (100 lb.)	lb.	.16 — .18
Ortho-cresol, in drums (100 lb.)	lb.	.25 — .27
Cresylic acid, 97–99%, straw color, in drums	gal.	.70 — .80
Cresylic acid, 95-97%, dark, in drums	gal.	.65 — .70
Cresylic acid, 50%, first quality, drums	gal.	.45 — .50
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	1.20 — 1.25
Dimethylaniline	lb.	.40 — .50
Dinitrobenzene	lb.	.26 — .28
Dinitroclorbenzene	lb.	.20 — .30
Dinitronaphthalene	lb.	.30 — .40
Dinitrophenol	lb.	.35 — .40
Dinitrotoluene	lb.	.27 — .30
Dip oil, 25%, car lots, in drums	gal.	.40 — .45
Diphenylamine	lb.	.60 — .65
H-acid	lb.	1.20 — 1.30
Meta-phenylenediamine	lb.	1.15 — 1.20
Monochlorbenzene	lb.	.12 — .14
Monoethylaniline	lb.	1.75 — 1.85
Naphthalene crushed, in bbls.	lb.	.07 — .08¼
Naphthalene, flake	lb.	.07 — .08½
Naphthalene, balls	lb.	.08½— .09¼
Naphthionic acid, crude	lb.	.70 — .75
Nitrobenzene	lb.	.12 — .15
Nitro-naphthalene	lb.	.30 — .35
Nitro-toluene	lb.	.16 — .18
Ortho-amidophenol	lb.	3.10 — 3.20
Ortho-dichlor-benzene	lb.	.15 — .20
Ortho-nitro-phenol	lb.	.80 — .85
Ortho-nitro-toluene	lb.	.15 — .20
Ortho-toluidine	lb.	.20 — .25
Para-amidophenol, base	lb.	1.50 — 1.60
Para-amidophenol, HCl	lb.	1.75 — 1.80
Para-dichlorbenzene	lb.	.15 — .20
Paranitroaniline	lb.	.85 — 1.00
Para-nitrotoluene	lb.	.85 — .95
Para-phenylenediamine	lb.	1.75 — 2.00
Para-toluidine	lb.	1.25 — 1.40
Phthalic anhydride	lb.	.50 — .60
Phenol, U. S. P., drums	lb.	.11 — .13
Pyridine	gal.	2.00 — 3.50
Resorcinol, technical	lb.	1.75 — 1.85
Resorcinol, pure	lb.	2.25 — 2.30
Salicylic acid, tech., in bbls.	lb.	.19 — .22
Salicylic acid, U. S. P.	lb.	.20 — .25
Salol	lb.	.80 — .85
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.25 — .28
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.14 — .16
Sulphanilic acid, crude	lb.	.30 — .35
Tolidine	lb.	1.25 — 1.35
Toluidine, mixed	lb.	.40 — .45
Toluene, in tank cars	gal.	.25 — .28
Toluene, in drums	gal.	.28 — .31
Xylidines, drums, 100 gal.	lb.	.40 — .45
Xylene, pure, in drums	gal.	.40 — .45
Xylene, pure, in tank cars	gal.	.45 — ....
Xylene, commercial, in drums, 100 gal.	gal.	.33 — .35
Xylene, commercial, in tank cars	gal.	.30 — ....

Waxes

Prices based on original packages in large quantities.

Beeswax, refined, dark	lb.	$0.24 — $0.25
Beeswax, refined, light	lb.	.27 — .28
Beeswax, white pure	lb.	.42 — .45
Carnauba, Flora	lb.	.58 — .60
Carnauba, No. 2, North Country	lb.	.25 — .26
Carnauba, No. 3, North Country	lb.	.15½— .16
Japan	lb.	.17 — .17½
Montan, crude	lb.	.06½— .06½
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.03½— .03¾
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½— ....
Paraffine waxes, refined, 118-120 m.p.	lb.	.03½— .03¾
Paraffine waxes, refined, 125 m.p.	lb.	.04 — .04¼
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 — .05
Paraffine waxes, refined, 133-135 m.p.	lb.	.05 — .05½
Paraffine waxes, refined, 135-137 m.p.	lb.	.05½— .06
Stearic acid, single pressed	lb.	.09 — ....
Stearic acid, double pressed	lb.	.09½— ....
Stearic acid, triple pressed	lb.	.10 — .10½

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb.	$5.00 —	....
Rosin E-I	280 lb.	5.30 —	5.50
Rosin K-N	280 lb.	5.70 —	6.50
Rosin W. G.-W. W	280 lb.	6.60 —	....
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	.58½ —	....
Wood turpentine, steam dist	gal.	.56 —	....
Wood turpentine, dest. dist.	gal.	.54 —	....
Pine tar pitch, bbl	200 lb.	..... —	6.75
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	11.50
Retort tar, bbl	500 lb.	—	11.50
Rosin oil, first run	gal.	.35 —	....
Rosin oil, second run	gal.	.38 —	....
Rosin oil, third run	gal.	.43 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		$1.80
Pine oil, pure, dest. dist	gal.		1.50
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.35
Turpentine, crude, sp. gr., 0.900-0.970	gal.		1.20
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.35
Pinewood creosote, ref	gal.		.52

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	$0.41
70-72 deg., steel bbls. (85 lb.)	gal.	.39
68-70 deg., steel bbls. (85 lb.)	gal.	.38
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.30

Crude Rubber

Para—Upriver fine	lb.	$0.16 —	.17
Upriver coarse	lb.	.09 —	.09½
Upriver caucho ball	lb.	.11½—	.12
Plantation—First latex crepe	lb.	.14½ —	....
Ribbed smoked sheets	lb.	.12 —	.12½
Brown crepe, thin, clean	lb.	.15 —	....
Amber crepe No. 1	lb.	.17 —	....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.08½ —	$0.09
Castor oil, AA, in bbls	lb.	.10 —	.10½
China wood oil, in bbls. (f.o.b. Pac. coast)	lb.	.14½ —	.15
Cocoanut oil, Ceylon grade, in bbls	lb.	.10½ —	.10½
Cocoanut oil, Cochin grade, in bbls	lb.	.11 —	.11½
Corn oil, crude, in bbls	lb.	.07½ —	.07¾
Cottonseed oil, crude (f. o. b. mill)	lb.	.05½ —	.05¾
Cottonseed oil, summer yellow	lb.	.07¼ —	.08
Cottonseed oil, winter yellow	lb.	.08 —	....
Linseed oil, raw, car lots (domestic)	gal.	.73 —	.75
Linseed oil, raw, tank cars (domestic)	gal.	.67 —	....
Linseed oil, in 5-bbl lots (domestic)	gal.	.75 —	.77

Olive oil, Denatured	gal	$1.35 —	$1.45
Palm, Lagos	lb.	.06 —	.07
Palm, Niger	lb.	.05½ —	.05¾
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.06 —	.06¼
Peanut oil, refined, in bbls	lb.	.10 —	.10¼
Rapeseed oil, refined in bbls	gal.	.88 —	.90
Rapeseed oil, blown, in bbls	gal.	.94 —	.95
Soya bean oil (Manchurian), in bbls, N. Y.	lb.	.07¼ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.05¼ —	...
FISH			
Light pressed menhaden	gal.	$0.42 —	....
Yellow bleached menhaden	gal.	.44 —	....
White bleached menhaden	gal.	.46 —	....
Blown menhaden	gal.	.50 —	....

Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	$24.00 —	30.00
Barytes, ground, off color, f.o.b. Kings Creek	net ton	22.00 —	26.00
Barytes, crude, 88%@94% ba., Kings Creek	net ton	10.00 —	12.00
Barytes, floated, f.o.b. St. Louis	net ton	26.50 —	28.00
Barytes, crude, first grade, Missouri	net ton	7.00 —	....
Blanc fixe, dry	lb.	.04½ —	.04¾
Blanc fixe, pulp	net ton	45.00 —	55.00
Casein	lb.	.08 —	.10
Chalk, domestic, extra light	lb	.04½ —	.05
Chalk, domestic, light	lb.	.04 —	.04½
Chalk, domestic, heavy	lb.	.03½ —	.04
Chalk, English, extra light	lb.	.04½ —	.05
Chalk, English, light	lb.	.04½ —	.05
Chalk, English, dense	lb.	.04 —	.04½
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	8.00 —	10.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	12.00 —	15.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	18.00 —	22.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaolin) ground, f.o.b. Virginia points	net ton	15.00 —	25.00
China clay (kaolin), imported, lump	net ton	12.00 —	20.00
China clay (kaolin), imported, powdered	net ton	20.00 —	25.00
Feldspar, crude, f.o.b. Maryland and North Carolina points	gross ton	8.00 —	14.00
Feldspar, crude, f.o.b. Maine	net ton	7.50 —	10.00
Feldspar, ground, f.o.b. Maine	net ton	21.00 —	23.00
Feldspar, ground, f.o.b. North Carolina	net ton	17.00 —	21.00
Feldspar, ground, f.o.b. N. Y. State	net ton	17.00 —	21.00
Feldspar, ground, f.o.b. Baltimore	net ton	27.00 —	30.00
Fullers earth, f.o.b. Mines	net ton	16.00 —	17.00
Fullers earth, granular, f.o.b. Pa	net ton	15.00 —	18.00
Fullers earth, powdered, f.o.b. Fla	net ton	18.00 —	....
Fullers earth, imported, powdered	net ton	24.00 —	27.00
Graphite, Ceylon lump, first quality	lb.	.07½ —	.08
Graphite, Ceylon chip	lb.	.06 —	.06½
Graphite, high grade amorphous crude	lb.	.02½ —	.03
Pumice stone, imported, lump	lb.	.04 —	.50
Pumice stone, domestic lump	lb.	.05 —	.05½
Pumice stone, ground	lb.	.06 —	.07
Quartz (acid tower) first to head, f.o.b. Baltimore	net ton	..... —	10.00
Quartz (acid tower) 1½@2 in., f.o.b. Baltimore	net ton	..... —	14.00
Quartz (acid tower) rice, f.o.b. Baltimore	net ton	..... —	17.00
Quartz, lump, f.o.b. North Carolina	net ton	5.00 —	7.50
Shellac, orange fine	lb.	.68 —	....
Shellac, orange superfine	lb.	.70 —	.71
Shellac, A. C. garnet	lb.	.53 —	.54
Shellac, T. N	lb.	.65 —	.67
Soapstone	ton	12.00 —	15.00
Sodium chloride	long ton	12.50 —	13.00
Talc, paper-making grades, f.o.b. Vermont	ton	11.00 —	20.00
Talc, roofing grades, f.o.b. Vermont	ton	8.50 —	13.00
Talc, rubber grades, f.o.b. Vermont	ton	11.00 —	18.00
Talc, powdered, Southern, f.o.b. cars	ton	10.00 —	14.00
Talc, imported	ton	30.00 —	40.00
Talc, California talcum powder grade	ton	18.00 —	40.00

Refractories

Bauxite brick, 56% Al, f.o.b. Pittsburgh	per ton	$37.50–40.00	
Carborundum refractory brick, 9-in. — less than carlot	1,000	1250.00	
Carborundum refractory brick, 9-in. — carload lots	1,000	1100.00	
Chrome brick, f.o.b. Eastern shipping points	net ton	60	
Chrome cement, 40–45% Cr_2O_3	net ton	30– 32	
Chrome cement, 40–45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	33– 35	
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	36– 40	
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	30– 35	
Magnesite brick, 9-in. straight	net ton	70	
Magnesite brick, 9-in. arches, wedges and keys	net ton	77	
Magnesite brick, soaps and splits	net ton	98	
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	42– 45	
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	46– 50	
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa	1,000	35– 38	

Ferro-Alloys

All f.o.b. Works

Ferro-titanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00 —	$225.00
Ferrochrome per lb. of Cr. contained, 6–8% carbon, carlots	lb.	.14 —	....
Ferrochrome, per lb. of Cr. contained, 4–6% carbon, carlots	lb.	.15 —	....
Ferromanganese, 76-80% Mn, domestic	gross ton	70.00 —	75.00
Ferromanganese, 76-80% Mn, English	gross ton	70.00 —	75.00
Spiegeleisen, 18-22% Mn	gross ton	27.00 —	28.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.50 —	.....
Ferrosilicon, 10-15%	gross ton	40.00 —	42.00
Ferrosilicon, 50%	gross ton	68.00 —	70.00
Ferrosilicon, 75%	gross ton	140.00 —	145.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.45 —	50
Ferrouranium, 35-50% of U, per lb. of U content	lb.	6.00 —	.....
Ferrovanadium, 30-40% per lb. of contained V	lb.	5.00 —	6.50

Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content	gross ton	$8.00 —	$10.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	unit	.35 —	.40
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	unit	.35 —	.40
Coke, foundry, f.o.b. ovens	net ton	4.00 —	4.50
Coke, furnace, f.o.b. ovens	net ton	3.00 —	3.25
Coke, petroleum, refinery, Atlantic seaboard	net ton	14.00 —	15.00
Fluorspar, lump, f.o.b. mines, New Mexico	net ton	12.50 —	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	18.00 —	20.00
Ilmenite, 52% TiO_2 per lb. ore	lb.	.01½ —	.01¾
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	uni	.25 —	.....
Manganese ore, chemical (MnO_2)	gross ton	55.00 —	60.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.55 —	.60
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	30.00 —	.....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.14 —	.14
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.14 —	.14
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	.12 —	.13
Rutile, 95% TiO_2 per lb. ore	lb.	.15 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	2.75 —	3.00
Tungsten, Wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C	unit	3.00 —	3.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.50 —	2.50
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	.....
Zircon, washed, iron free	lb.	.03 —	.....

Non-Ferrous Metals

New York Markets

	Cents per Lb.
Copper, electrolytic	12.75
Aluminum, 98 to 99 per cent	28.0@28.5
Antimony, wholesale lots, Chinese and Japanese	4¾
Nickel, ordinary (ingot)	41.00
Nickel, electrolytic	44.00
Monel metal, spot and blocks	35.00
Monel metal ingots	38.00
Monel metal, sheet bars	40.00
Tin, 5-ton lots, Straits	29.00
Lead, New York, spot	4.40
Lead, E. St. Louis, spot	4.12–4.25
Zinc, spot, New York	4.55
Zinc, spot, E. St. Louis	4.20–4.25

OTHER METALS

Silver (commercial)	oz.	$0.59
Cadmium	lb.	1.00–1.25
Bismuth (500 lb. lots)	lb.	1.50@1.55
Cobalt	lb.	4.00
Magnesium (f.o.b. Philadelphia)	lb.	1.25
Platinum	oz.	75.00
Iridium	oz.	160.00@180.00
Palladium	oz.	65.00–70.00
Mercury	75 lb.	46.00–47.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	21.25–21.50
Copper bottoms	28.75–29.00
Copper rods	20.00
High brass wire	17.25
High brass rods	14.25
Low brass wire	18.75
Low brass rods	18.75
Brazed brass tubing	27.50
Brazed bronze tubing	32.25
Seamless copper tubing	22.00
Seamless high brass tubing	20.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York Current	Cleveland	Chicago
Copper, heavy and crucible	9.25@ 9.50	9.25	9.50
Copper, heavy and wire	8.25@ 8.50	8.50	8.50
Copper, light and bottoms	7.25@ 7.75	7.50	7.25
Lead, heavy	3.25@ 3.50	3.25	3.25
Lead, tea	2.25@ 2.35	2.25	2.25
Brass, heavy	4.25@ 4.50	4.50	5.00
Brass, light	3.25@ 3.50	3.25	3.50
No. 1 yellow brass turnings	4.25@ 4.50	4.25	4.50
Zinc	2.00@ 2.50	2.00	2.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Cleveland	Chicago
Structural shapes	$2.60	$3.23	$3.23
Soft steel bars	2.50	3.00	3.13
Soft steel bar shapes	2.50	3.13	3.13
Soft steel bands	2.85	3.83	3.78
Plates, ¼ to 1 in. thick	2.50	3.30	3.23

*Add 15c per 100 lb. for trucking to Jersey City and 10c for delivery in New York and Brooklyn

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

PINEY POINT—The Florida Oil Refining Association, Tampa, Fla., has preliminary plans in preparation for the erection of a new refinery at Piney Point. A local tract, comprising about 1,100 acres of land, has been acquired as a site; the plant will be of two-unit type, with daily output of about 2,000 bbl. A storage capacity of 80,000 bbl. will be provided. The new plant is estimated to cost about $250,000, including equipment.

Arkansas

EL DORADO—The Union Pipe Line & Refining Co. has completed a new local refinery and operations have been inaugurated. The plant is of 5,000-bbl. capacity and will handle crude oil from this district exclusively. The company has another refining plant under construction, and plans to have the unit ready for service early in August.

California

LOS ANGELES—The Bradley-Wise Paint Co., 650 Santa Fe Ave., has arranged for an increase in capital from $50,000 to $150,000, and has tentative plans under way for the establishment of a new plant. It is said that a number of local sites are being considered.

SAN JOSE—The plant of the Fred Cooke Oil Co. was partly destroyed by fire, June 11, with loss estimated at about $30,000. The company is reported to be planning for early rebuilding.

LOS ANGELES—C. H. Winkelman, formerly president and general manager of the California Varnish Co., has organized a company to be known as C. H. Winkelman & Co., to operate a plant at 2416-26 San Leandro St., for the manufacture of paints, enamels, varnishes, etc. P. M. Waldron will act as factory superintendent.

SUMMERLAND — The Department of Agriculture, Washington, D. C., has taken bids for the sale of the Government kelp potash plant here. The highest bid received, totaling $35,000, is said to be irregular and not in accord with conditions. The next highest bid, for $25,000, was made by M. E. Saville, San Francisco.

LOS ANGELES — The Republic Steel Package Co., 7930 Jones Rd., has acquired property here for the erection of a new plant for Pacific Coast service. The initial plant unit will be 60 x 300 ft., and will be equipped to give employment to about 100 operatives. S. B. Merry is treasurer.

Idaho

BOISE — Edward Crassen, Baker, Ore., and associates are considering the erection of a new plant in the vicinity of Boise for the manufacture of paint, varnish, etc.

Illinois

CHICAGO—The Carbo Oxygen Co., affiliated with the Carbo Hydrogen Co., 10305 Torrence Ave., has construction under way on a new plant at 10329-41 Torrence Ave., to be 1-story, 55 x 140 ft., and estimated to cost about $18,000. W. G. Langenheim, 333 South Dearborn St., is engineer.

Indiana

CHESTERTON—The United States China Co. will soon commence the erection of an addition to its local plant, to comprise a number of buildings. A new main 2-story structure, 100 x 300 ft., will be built, with adjoining building, 50 x 50 ft., to be equipped as a sagger manufacturing department. Five new kilns will be constructed. the work is estimated to cost close to $100,000.

INDIANAPOLIS—The Standard Oil Co. of Indiana is completing negotiations for the purchase of the Midwest Refining Co., the acquisition to include all oil refineries and other property. The Standard company recently increased its capital from $100,000,000 to $140,000,000. A large portion of the increase, it is said, will be used for the proposed purchase.

Louisiana

SHREVEPORT—The plant of the Henderson Cotton Oil Co. was destroyed by fire, June 22, with loss estimated at $300,000, including machinery. A number of buildings sustained a large loss, including main mill and lint department.

Maryland

BALTIMORE — The Zirconium Co. of America, Monument and Eleventh Sts., recently organized to manufacture ferrozirconium and other products, will install an electrochemical plant at its new works for oxide production. George F. Dixon is president.

BEL AIR—The Maryland Flint & Feldspar Co. has perfected plans for the construction of a new plant near Bel Air, to replace its present works. It is estimated to cost about $250,000, including machinery.

BALTIMORE — The Rasin - Monumental Co., National Marine Bldg., is arranging preliminary plans for the erection of its proposed new fertilizer manufacturing plant on Fairfield St., estimated to cost close to $1,000,000 with machinery. The plant will be used as an extension to the company's works in the Curtis Bay section.

BALTIMORE — The International Chemical Products Co., 13 West Saratoga St., recently organized, has plans under way for the erection of a new plant for the manufacture of pulp and paper products, extracts, etc. Six buildings will be erected at a cost of about $25,000, and machinery and equipment estimated to cost $75,000 installed. The latter will include extracting, evaporating, refining and other apparatus. The company is capitalized at $150,000. W. A. Gardner is president, and Frank L. La Motte secretary

BALTIMORE—The Gwynns Falls Paper Co., 517 Calvert Bldg., has taken title to property in the Gwynns Falls section, comprising about 5 acres of land, as a site for the erection of its proposed new paper mill, estimated to cost about $250,000 with machinery. Joseph H. Wallace & Co., 5 Beekman St., New York, are engineers. George W. Davis is head.

Massachusetts

SPRINGFIELD — The Springfield Bronze Foundry Co. has awarded a contract to the M. J. O'Connell Co., 23 Murray Hill St., for the erection of its proposed new foundry for the manufacture of brass and bronze castings, at 166 Charles St. It will be 40 x 50 ft.

Michigan

DETROIT—Parke, Davis & Co., 2951 Atwater St., manufacturer of chemicals, etc., has construction under way on a new 2-story building, 100 x 200 ft., to cost about $60,000. Frank H. Davis, 1838 Penobscot Bldg., has the erection contract.

Missouri

ST. LOUIS—The Chester Iron & Foundry Co., 7800 Vulcan St., has taken bids for the erection of a new 1-story foundry and plant addition, 45 x 117 ft., to cost about $40,000. A. J. Schaelich is president.

ST. LOUIS—The Fleischmann Yeast Co., 1535 Market St., has awarded a contract to Kremer & Voirol, St. Louis, for the erection of its proposed new 1-story plant on the Forest Park Blvd., near Bogle Ave., 75 x 170 ft., estimated to cost about $50,000.

Montana

WINNET—The Southern Alberta Refineries, Ltd., Calgary, Alta., is planning for the erection of a new oil refinery at Winnett. A site has been acquired and the proposed plant is estimated to cost about $100,000. William Livingston is president.

Nevada

TONOPAH — The West End Chemical Co., affiliated with the West End Consolidated Mines Co., headed by F. G. (Borax) Smith, San Francisco, Cal., is planning for the early operation of a new plant in southern Nevada for the production of refined borax. The company has an extensive colemanite deposit in this section and will develop the property on a large scale.

New Jersey

EDGEWATER—The Archer-Daniels Linseed Co., Twenty-ninth Ave., Minneapolis, Minn., is completing plans for the erection of its proposed new linseed oil works on property recently acquired at Edgewater. It is understood that bids for erection and equipment will be asked at an early date.

TRENTON — A creditors' committee, headed by Edgar W. Hunt, Trenton, has acquired the local plant of the Trent Rubber Co., Enterprise Ave., for a consideration said to be $100,000, and will continue the plant in operation.

Ohio

DOVER—The Harbison-Walker Refractories Co., Pittsburgh, Pa., has disposed of its local clay properties to S. A. McCaskey, said to represent the Wayne Coal Co., which proposes to operate on the site. The property is located in the Strasburg section, and was sold for a consideration said to be $40,000.

CLEVELAND—The Empire Rolling Mill Co., Bessemer Ave. and the Pennsylvania R.R., has commenced the erection of a new 1-story building at its plant, to be used as a steel-galvanizing works. With warehouse building to be constructed, it is estimated to cost about $50,000. C. G. Berkwell is president.

Pennsylvania

ERIE—The Keystone Rubber Mfg. Co. 1413 East Eleventh St., manufacturer of mechanical rubber goods, is taking bids for the rebuilding of its plant, recently destroyed by fire with loss estimated in excess of $100,000. It will be 3-story, 123 x 165 ft. J. M. Blake, Commercial Bldg., is engineer.

Tennessee

ANDERSON—The Robinson Lime Co., recently organized with a capital of $250,000, has plans under way for the erection of a new lime-manufacturing plant on local site, with initial daily output of about 50 tons. Complete grinding and crushing departments will be installed. A. J. Robinson is president and M. H. Bates treasurer.

Texas

HOUSTON—James A. Harley, Houston, is organizing a local company to establish a new plant in the Bethany-Elysian gas field, Harrison Co., for the production of carbon black. The proposed works are estimated to cost in excess of $500,000 with machinery.

BRIDGEPORT—The Edmonds Oil & Refining Co. has acquired the refinery of the Bridgeport Refining Co., and has plans under way for extensions and improvements for increased production.

COMMERCE — The Trinity Paper Mills Co., which recently commenced operations at a new local mill for the manufacture of paper pulp from cottonseed linters, is considering preliminary plans for the construction of branch mills for similar production at Fort Worth and McKinney, Tex.

BROWNWOOD—The Texas Oil & Gas Refineries Co., recently reorganized, is planning for the installation of additional equipment for gasoline production. Philip J. Baney is president and general manager.

Utah

SALT LAKE CITY—The Utah Oil Refining Co. is planning for the rebuilding of its plant, destroyed by fire, June 11, with loss reported in excess of $500,000, including buildings and equipment.

Virginia

WINCHESTER — The Cornwell Lime-Marl Co. has plans in preparation for the erection of a new plant 25 x 68 ft. and 25 x 90 ft., with initial daily capacity of about 125 tons of lime marl. The plant will cost about $25,000. C. J. Swank is general manager.

ROANOKE — The Viscose Co., Marcus Hook, Pa., manufacturer of artificial silk products, is reported to be planning for the erection of additions to its local plant, to double the present output.

New Companies

THE F. W. MUIR BOARD CO., Morristown, N. J., has been incorporated with a capital of $100,000 to manufacture paperboard products. The incorporators are Franklin W. Muir, Robert H. McLeod and Oliver K. Day, Park Place, Morristown.

MARTIN-WALSH, INC., New York, N. Y., has been incorporated with a capital of $70,000 to manufacture paper products. The incorporators are W. Martin, A. R. and J. C. Walsh, Jr. The company is represented by O. M. Bate, 26 Liberty St.

THE SPRINGFIELD WIRE & TINSEL CO., Springfield, Mass., has been incorporated with a capital of $600,000 to manufacture wire products and kindred specialties. Gerald J. Callahan is president; and Edward S. Bradford, Springfield, treasurer.

THE MARK DELISSER CORP., New York City, has been incorporated with a capital of $100,000 to manufacture chemicals and affiliated products. The incorporators are Mark Delisser, J. Dubow and M. B. Lesser, 132 Nassau St.

THE SERVICE PAINT & VARNISH WORKS, INC., Brooklyn, N. Y., has been incorporated with a capital of $10,000 to manufacture paints, varnishes, etc. The incorporators are C. A. and J. C. Osterholm, W. D. MacNaughton, and J. A. Johnson, 91 Kenmore Pl., Brooklyn.

THE LUDINGTON NOVELTY MFG. CO., Ludington, Mich., has been incorporated with a capital of $50,000 to manufacture steel needles and kindred products. The incorporators are Bernard Ostendorf, L. E. Vorse, and William C. Killean, Ludington.

THE SEPOY DYE PRODUCTS CORP., New York City, has been incorporated with a capital of $150,000 to manufacture chemicals, dyestuffs, etc. G. Bothamley, 77 Pine St., is the principal incorporator.

THE UNITED STATES PORCELAIN CO., Trenton, N. J., has been incorporated with a capital of $100,000, to manufacture porcelain wares and other ceramic products. The incorporators are John Janus and Carl Markau, 54 Seward Ave.

THE SOBOS OIL CORP., New York City, has been incorporated with a capital of $16,000 to manufacture oil products. The incorporators are W. Davis, A. Conant, and W. C. Arnold, 120 B'way.

THE OZARK PETROLEUM CO., Willow Springs, Mo., has been incorporated with a capital of $200,000 to manufacture petroleum products. L. O. Neider is president; and Dr. S. E. Haycraft, vice-president, both of Willow Springs.

THE CLARKSVILLE SEED CO., Clarksville, Tenn., has been incorporated with a capital of $35,000 to manufacture cottonseed oil specialties. The incorporators are F. A. Antone and R. Isbell, Clarksville.

THE MOBILE PAINT MFG. CO., Mobile, Ala., has been incorporated with a capital of $50,000 to manufacture paints, varnishes, etc. W. A. Benson is president; H. R. Luscher, treasurer; and Carter Luscher, secretary, all of Mobile.

DYAS & LEGROS, INC., 5514 West Lake St., Chicago, Ill., has been incorporated with a capital of $15,000 to manufacture chemicals and chemical byproducts. The incorporators are Clair S. Dyas and Emil A. LeGros.

THE O. C. BARBER LIME CO., Room 48, 10 South St., Baltimore, Md., has been incorporated with a capital of $600,000 to manufacture lime products. The incorporators are Clarence W. Perkins, Addison E. Hook and Mullin Wilson.

THE SHEPHARD CHEMICAL CO., New York City, has been incorporated with a capital of $30,000 to manufacture chemicals, insecticides and kindred products. The incorporators are N. P. Cullom, F. B. Ryan and E. C. Dickinson. The company is represented by Cullom & Rinke, 165 B'way.

THE MONTVILLE PAPER CO., Montville, Conn., has been incorporated with a capital of $50,000 to manufacture and deal in paper, paper boxes and affiliated specialties. The incorporators are R. C. Burchard, Montville; F. W. Mercer and F. L. McGuire, 64 Huntington St., New London, Conn.

THE SHAWMUT DRUG & CHEMICAL CO., Boston, Mass., has been incorporated with a capital of $10,000 to manufacture chemical products. Joseph M. McManus, 496 Main St., Charlestown, Mass., is treasurer; Charles Costello and Dennis McCarthy are directors.

THE NEW JERSEY OIL REFINING CO., Keyport, N. J., has been incorporated with a capital of $2,500,000 to manufacture refined oil products. The incorporators are Robert Thysem, Earl U. Bartholomew and Arthur L. Turner, Keyport.

THE PUENTE MID-CENTRAL OIL CO., Los Angeles, Cal., has been incorporated with a capital of $1,000,000 to manufacture petroleum products. The incorporators are G. G. Russell, W. M. Miller and Walter F. Wilkinson. The company is represented by Walter H. Sprague, 811 H. W. Hellman Bldg.

THE G. & R. MFG. CO., Tampa, Fla., has been incorporated with a capital of $25,000 to manufacture soap products. L. F. Goonrey is president and M. D. Reay secretary and treasurer, both of Tampa.

THE WOVEN LEATHER CORP., Brooklyn, N. Y., has been incorporated with a capital of $100,000 to manufacture leather products. The incorporators are N. H. Dimon, M. P. Murphy and P. H. Loftus, 80 B'way.

THE ILLINOIS BARITE CO., Main St., Golconda, Ill., has been incorporated with a capital of $150,000 to operate mineral properties with refining plant. The incorporators are Leslie Wardrop, James Wardrop and G. W. Casey.

THE FREDERICKSEN CO., Saginaw, Mich., has been incorporated with a capital of $100,000 to manufacture brass, bronze, aluminum and other metal castings. The incorporators are Niels J. Fredericksen, 5740 Lorain Ave., Detroit, Mich.; Alexander M. Lemke and Otto Schrupp, Saginaw.

THE CORTEX CHEMICAL WORKS, Brooklyn, N. Y., has been incorporated with a capital of $30,000 to manufacture chemicals and chemical byproducts. The incorporators are L. Kuhne, C. Zengerie and D. Spero. The company is represented by B. G. Greller, 299 B'way, New York.

THE JEWELERS' SMELTING CO., INC., Newark, N. J., has been incorporated with a capital of $100,000 to operate a smelting and refining works for gold and other materials. The incorporators are Marcel Godefroy, Milton A. and Harry C. Helmlinger. The company is represented by Charles S. Smith, 207 Market St.

THE H. K. T. OIL CO., Los Angeles, Cal., has been incorporated with a capital of $350,000 to manufacture petroleum products. The incorporators are Roy Lauman, J. A. Rasmussen and Theodore Wittler. The company is represented by Joseph Crail, Union Oil Bldg.

THE TRANSLOID PRODUCTS CO., New York City, has been incorporated with a capital of $500,000 to manufacture translucent sheeting and other composition products. The incorporators are W. A. Scanlan, L. Meyers and L. Tyler, 51 Chambers St.

THE ORGANIC FERTILIZER CO., Lakeland, Fla., has been incorporated with a capital of $500,000 to manufacture fertilizer products. The incorporators are W. T. Overstreet, Edwin Spencer, Jr., and W. B. Sewell, Lakeland.

THE ONONDAGA SALT CO., Syracuse, N. Y., has been incorporated with a nominal capital of $5,000 to manufacture salt products. The incorporators are T. K. Gale, D. W. Peck and T. P. Murray. The company is represented by Daniel A. Pierce, Wieting Bldg.

THE OIL & CHEMICAL CORP., Chicago, Ill., has been incorporated under Delaware laws with a capital of $335,000 to manufacture chemicals, oils, etc. The incorporators are Abraham Greensphan, A. L. Rittenberg and Lawrence A. Cohen, 11 South La Salle St., Chicago.

THE NATURAL OXIDE CORP., Ford City, Pa., has been incorporated with a capital of $500,000 to manufacture oxides, purifying materials for gas plants and kindred products. The incorporators are Leroy John, Harry Butler, Ford City; and Guy Ross, Oakmont, Pa.

THE PEERLESS CORK CO., 26 Prospect St., Newark, N. J., has filed notice of organization to manufacture cork products. Charles A. Hauser, 61 Linden St., Irvington, Newark, heads the company.

THE CHARLES B. CHRYSTAL CO., New York City, has been incorporated with a capital of $200,000 to manufacture waxes, chemicals, etc. The incorporators are C. B. and O. Chrystal, and J. Ormiston. The company is represented by F. J. Knorr, attorney, Albany, N. Y.

THE AUBURN PARK OIL CO., 7222 Green St., Chicago, Ill., has been incorporated with a capital of $100,000 to manufacture and deal in oil products. The incorporators are Otto Miller, Hugh J. McHugh and W. Gottwold.

THE SOUTH SIDE OIL CO., Salamanca, N. Y., has been incorporated with a capital of $35,000 to manufacture oil products. The incorporators are R. C. Cooney, T. Conlan and G. A. Adams, Salamanca.

SCHWITTER, CLOVER & STARKWEATHER, INC., Newark, N. J., has been incorporated with a capital of $125,000 to operate a metal smelting and refining plant. The incorporators are Martin Schwitter, Charles Clover and George W. Starkweather, 320 Passaic Ave.

THE CLAROTYPE CO., New York City, has been incorporated with a capital of $100,000 to manufacture type-cleaning fluids and other chemical compounds. The incorporators are L. and E. Banov, A. Henderson and L. Mintz, 19 West 44th St.

Industrial Notes

THE CHEMICAL EQUIPMENT CO. announces the removal of its general offices from 910 Monadnock Bldg. to 2457-59 South Western Ave., Chicago, Ill.

HUGO SCHLATTER has resigned his position as manager of the chemical products division of the Hercules Powder Co. and plans a trip to Europe early in July. While abroad he will visit industrial centers and is prepared to undertake commissions for American manufacturers who desire special investigations and reports on conditions abroad. Mr. Schlatter may be addressed at P.O. Box 26, Wilmington, Del.

THE ELECTRIC HEATING APPARATUS CO. announces the removal of its general offices and factory to 18-34 Nesbitt St., Newark, N. J.

Capital Increases, Etc.

THE SINCLAIR & VALENTINE CO., 611 West 129th St., New York City, manufacturer of lithographing inks, etc., has filed notice of increase in capital from $400,000 to $1,600,000.

THE EAGLE LAKE BRICK & TILE WORKS, Eagle Lake, Ill., has filed notice of dissolution under state laws.

THE MAC SIM BAR PAPER CO., Otsego, Mich., has filed notice of increase in capital from $1,200,000 to $2,400,000.

THE GOODYEAR RUBBER CO., 787 B'way, New York City, has filed notice of increase in capital from $500,000 to $2,615,000.

THE ROOSEVELT DRUG & CHEMICAL CO., 117 Smith St., Perth Amboy, N. J., has been granted a certificate of dissolution under state laws.

THE BARTLES-SWEENEY OIL CO. OF ILLINOIS, Peoria, Ill., has filed notice of increase in capital from $15,000 to $300,000, at the same time changing its name to the Sweeney Gasoline & Oil Co.

WILLIAM S. GRAY has been appointed receiver for RALPH L. FULLER & CO., 81 Fulton St., New York City, manufacturers of chemicals and paints, in bond of $50,000. The company's liabilities are said to aggregate $480,000, with assets in excess of this sum.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY'S summer meeting will be held at Canton, Alliance, Sebring and East Liverpool, Ohio, July 25 to 27. Headquarters will be at the Hotel Courtland, Canton, Ohio.

AMERICAN CHEMICAL SOCIETY, THE SOCIETY OF CHEMICAL INDUSTRY and the American Section of the latter society will hold a joint meeting in New York, Sept. 6 to 10.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Lake Placid, N. Y., Sept. 29 and 30, and Oct. 1.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its fall meeting at Wilkes-Barre, Pa., Sept. 12 to 17.

AMERICAN MINING CONGRESS AND NATIONAL EXPOSITION OF MINES AND MINING EQUIPMENT will hold its twenty-fourth annual convention in the Coliseum, Chicago, Oct. 17 to 22.

AMERICAN SOCIETY FOR STEEL TREATING will hold its third annual convention and exhibition Sept. 19 to 24 at Indianapolis.

THE NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (SEVENTH) will be held during the week of Sept. 12 in the Eighth Coast Artillery Armory, New York City.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer and will resume them in October.

SOCIETY OF CHEMICAL INDUSTRY (BRITISH) at the invitation of the Montreal section will hold its annual meeting in Montreal and other Canadian cities during the week of Aug. 29, 1921. Details will be printed in this magazine from time to time.